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SCRIPTS AND LITERACY

*Reading and Learning to Read Alphabets,
Syllabaries and Characters*

Edited by

INSUP TAYLOR

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The purpose of the Neuropsychology and Cognition series is to bring out volumes that promote understanding in topics relating brain and behavior. It is intended for use by both clinicians and research scientists in the fields of neuropsychology, cognitive psychology, psycholinguistics, speech and hearing, as well as education. Examples of topics to be covered in the series would relate to memory, language acquisition and breakdown, reading, attention, developing and aging brain. By addressing the theoretical, empirical, and applied aspects of brain-behavior relationships, this series will try to present the information in the fields of neuropsychology and cognition in a coherent manner.

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TABLE OF CONTENTS

PREFACE

vii

1. An Introduction to Reading the World's Scripts
Insup Taylor & David R. Olson

PART I. OPTIONAL AND OPTIMAL SCRIPTS

2. Scripts and writing Systems: A Historical Perspective
Albertine Gaur 19
3. Optimal Orthographies
Henry Rogers 31
4. Logographic and Semasiographic Writing Systems: A Critique of Sampson's Classification
J. Marshall Unger & John DeFrancis 45
5. The Cree Syllabary and the Writing System Riddle: A Paradigm in Crisis
Suzanne McCarthy 59
6. Developing Orthographies: The Athapaskan Languages of the Northwest Territories, Canada
Keren D. Rice 77
7. Orthography and Reading in Kannada: A Dravidian Language
P. Prakash & R. Maiatesha Joshi 95

PART II: READING PROCESSES FOR DIFFERENT SCRIPTS

8. How English is Read: Grapheme-Phoneme Regularity and Orthographic Structure in Word Recognition
Richard L. Venezky 111
9. Getting at the Sound and Meaning of Logographic and Alphabetic Scripts
Runjahn Hoosain 131
10. Script Factors that Affect Literacy: Alphabetic vs, Logographic Languages
In-Mao Liu 145 In-
11. Orthographic and Psycholinguistic Considerations in Developing Literacy in Chinese
Che Kan Leong 163

12. Differential Processing of Content Words and Function Words:
Chinese Characters vs. Phonetic Scripts 185
Insup Taylor & Kwonsaeng Park

PART III: EARLY STAGE OF LEARNING TO READ

13. Teaching Japanese Toddlers to Read Kanji and Kana 199
Miho T. Steinberg
14. Asymmetries between Reading and Writing for Japanese Children 215
Jun Yamada
15. Reading Disabilities in Japan: Implications from the Study of Hemisphere Functioning 231
Takeshi Hatta & Takehito Hirose
16. Writing Systems and Acquisition of Reading in American Chinese and Japanese First-Graders 247
Shin-Ying Lee, David H. Uttal, & Chuansheng Chen
17. Brahmi Scripts, Orthographic Units and Reading Acquisition 265
Purushottam G. Patel
18. Orthographic and Cognitive Processing in Learning to Read English and Hebrew 277
Esther Geva

PART IV: COGNITIVE AND METALINGUISTIC IMPLICATIONS OF LEARNING TO READ

19. Script Directionality Affects Nonlinguistic Performance: Evidence from Hindi and Urdu 295
Jyotsna Vaid
20. Cognitive Consequences of L1 and L2 Orthographies 311
Keiko Koda
21. Lexical Representation of Script Variation: Evidence from Korean Biscryptals 327
Kwonsaeng Park & Jyotsna Vaid
22. Syllabic Literacy and Cognitive Performance among the Cree and Ojibwe People of Northern Canada 341
John W. Berry & Jo Anne Bennett
23. Orthography, Vision, and Phonemic Awareness 359
Robert J. Scholes

PREFACE

Literacy is of concern to all nations, developed or under-developed, of the world. In recognition of this fact, the year 1990 was designated by the United Nations as the International Year of Literacy. A literate person is one who is able to read and write so as to function adequately in society. And reading and writing is done in a particular writing system or script. What kind of scripts are used in the world today and how do they influence the acquisition, use, and spread of literacy?

To address this important and timely question, a group of international scholars were invited to participate in the conference, 'Scripts and Literacy: East and West' in Toronto on June 1-4, 1988. This volume is an outgrowth of that conference.

Altogether 32 speakers presented 26 papers, of which 20 have been selected as chapters for this volume. Three additional papers were solicited to round out the content of the volume.

The 23 chapters discuss learning and processing of a wide variety of scripts, some familiar and some unfamiliar, such as Chinese, Japanese, Korean, Arabic, Hebrew, Devanagari, and Cree. The chapters are organized in four major sections: 'I. Optional and Optimal Scripts,' 'II. Reading Processes for Different Scripts,' 'III. Early Stages of Learning to Read Eastern and Western Scripts,' and 'IV. Cognitive and Metalinguistic Implications of Learning to Read Various Scripts and Script Types.'

We thank the following organizations for funding the conference: the Social Sciences and Humanities Research Council of Canada, the Connaught Foundation, the Japan Foundation, and the Joint Council of the University of Toronto/Ontario Institute for Studies in Education. We also thank Sylvia Wookey and Marie McMullin for looking after the many and varied needs of the participants at the conference, Denese Coulbeck and J. Wibier for their assistance in the preparation of this volume.

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16. WRITING SYSTEMS AND ACQUISITION OF READING IN AMERICAN, CHINESE, AND JAPANESE FIRST-GRADERS

As the chapters in this volume indicate, researchers have shown an increasing interest in the relation between orthography, visual information processing, and reading comprehension. These issues are important, for although the study of reading is one of the oldest and most intensely investigated topics in psychology, most research has been conducted with subjects who read an alphabetic language, usually English. Studying similarities and differences in the processes involved in reading non-alphabetic orthographies provides a means of testing the generality of findings in the psychology of reading.

The focus of this chapter is on the comparison of the initial acquisition of literacy among children learning to read Chinese, Japanese, and English. Most research on the relation between the characteristics of writing systems and the acquisition of literacy has relied on theoretical analyses of the cognitive demands of learning to read the different writing systems. There have been few comparative studies of the acquisition of basic reading skills among children learning to read different types of writing systems. Researchers have suggested that some writing systems may be more or less difficult to read than others. but few researchers have actually tested their hypotheses.

A comparative study of the early acquisition of reading in Chinese, Japanese, and English is of interest for several reasons. First, these languages typically have been used as exemplars of three types of orthographies: logographic, syllabic, and alphabetic (Just and Carpenter, 1987). Thus, a comparative study of first-graders learning to read Chinese, Japanese, and English could provide insight into similarities and differences in the reading process of very different writing systems. Second, it has been claimed that the basic acquisition of a logographic writing system such as Chinese, or a syllabic writing system such as Japanese, may be easier than the acquisition of an alphabetic language, such as English. Gleitman and Rozin (1977), for example, suggested that reading a logographic orthography is easy because it does not require mastering an arbitrary system focusing on symbol-sound relations such as the ones in an alphabetic orthography. They also have suggested that a logographic orthography allows the child to focus more on the abstraction of meaning from text; children do not have to go through the intermediate step of deducing the sound of a word. Along these lines, researchers have noted that reading disabilities seem to be virtually unknown in countries that use logography or syllabic writing

systems (Makita, 1968; Rozin, Poritsky, and Sotsky, 1971). The arbitrary nature of the alphabetic system is blamed for the relatively high incidence of reading disabilities in the United States.

Empirical research suggests that Gleitman and Rozin's suggestion may not be correct. In a comparative study of elementary-school children's reading ability in Japan, Taiwan, and the U.S., Stevenson, Lee, Luckner, Kitamura, and Hsu (1982) found that the percentage of children with reading disabilities (defined as reading at a level at least two grades behind their current grade level) was comparable in the three countries. However, finding that the percentage of children with reading disabilities is comparable in the three cultures does not necessarily mean that the reading process is similar for children who learn to read Chinese, Japanese and English. Rather than focusing on the worst readers in the cultures, we are interested in the general influence of orthography on the initial acquisition of reading. Thus, in this report we compared the reading achievement patterns in Chinese, Japanese, and American first-grade children.

One other important reason to compare the early acquisition of reading in different writing systems is that children just learning to read may be influenced more by the effect of orthography than skilled readers. Tzeng and Kung (1980) concluded that the major effect of differences in writing systems involve primarily lower-level perceptual processes. Because the beginning reader's performance probably is much more strongly affected by these processes, it is interesting to study the differences in the early acquisition of reading in languages that use the three basic styles of orthography. Tzeng and Hung's work led us to hypothesize that early reading is most likely to show the effects of orthography than fluent reading, in which higher-level processes play a greater role.

One particular way in which Chinese, Japanese, and English differ that may affect the initial acquisition of reading concerns children's attempts to pronounce newly encountered words. In English and other alphabetic systems, it is possible for children to make a reasonable guess at the pronunciation of new words once they have mastered the sound patterns of the alphabet. Even though there is no direct, systematic grapheme-to-phoneme correspondence in English (Venezky, 1970), children can often make accurate guesses about the correct pronunciation of words they have not learned. In Chinese, however, the cues to pronunciation are much less direct and require more extensive knowledge of the characteristics of the language (Tzeng and Hung, 1981). In Japanese, the combination of two different types of writing systems, *kana* and *kanji*, also presents difficulties for the child learning to read. In this chapter we present data that consider the role of ease and use of pronunciation cues as a factor in the early acquisition of literacy in children learning to read Chinese, Japanese, and English.

We begin with a discussion of how children learn to pronounce Chinese

and Japanese. Following this, the method for constructing a test to compare the reading achievement of Chinese, Japanese, and American first-graders is outlined. Finally, we present data on Chinese, Japanese, and American first-graders' reading of **words** they have learned in their texts, and of words they have not yet encountered in the reading curriculum. The results are discussed in terms of the relation between orthographies and early reading achievement.

ORTHOGRAPHY AND PRONUNCIATION IN CHINESE AND JAPANESE

A review of the characteristics of the Chinese and Japanese writing systems is beyond the scope of this paper. [Reviews of Chinese and Japanese are available in Hung and Tzeng (1982). Just and Carpenter (1987), Taylor and Taylor (1983), Stevenson, Lee, and Stigler (1986), and Unger (1987).] Our focus is on how children learn to read and pronounce new words in learning these languages.

It is important to distinguish between the processes used by older children and adults and those used by children just learning to read. Hung and Tzeng (1981) have suggested that competent reading of all orthographies is a highly automatic process. In all languages, once readers become familiar with the majority of words that they encounter, they typically do not focus on the individual parts of the orthography (e.g., letters, radicals, syllabaries). For example, research has indicated that competent English-speaking children achieve a high degree of automaticity by about third grade; low-achieving third-graders continue to rely largely on the decoding of individual words (Perfetti and Hogaboarn, 1975). The pronunciation of Chinese characters, which are used both in written Chinese and written Japanese (*kanji*), usually cannot be predicted without some extensive prior knowledge of the writing system. Hung and Tzeng (1980) found that adult Chinese readers had about a 40% chance of correctly pronouncing words they had never seen before. In contrast, even young readers of English have a reasonably high chance of correctly pronouncing words once they have mastered the basics of the grapheme-phoneme correspondence.

How do children learn to read Chinese? At the beginning of the first semester of first-grade, children are taught to read a simple phonetic spelling system. These extra-orthographic systems are needed because without a great deal of prior knowledge, children have very little chance of being able to pronounce new characters correctly. In the People's Republic of China, the pinyin system is used. This system is based upon the Roman alphabet. In **Taiwan**, a syllabary system known as *zhuyin fuhao* is used. In the elementary textbooks, pinyin or *zhuyin fuhao* are printed beside all new characters to facilitate the pronunciation of the characters. After learning these systems, Chinese characters are introduced.

In Japan, early reading instruction focuses primarily on hiragana, the

syllabary. Most mothers attempt to teach their children at least some *hiragana* before the children enter first grade, and indeed most Japanese kindergartners are proficient with all 46 *hiragana* by the time they start first grade. Knowing *hiragana* is important because it provides a means of pronouncing all Japanese words. Although Japanese is written with a combination of Chinese characters (*kanji*) and syllable symbols (*kana*), Japanese can be written and read entirely in *kana*. By the end of first-grade children have learned to read about 76 *kanji*, these *kanji* are presented with *furigana*, which are small versions of the *hiragana* printed beside a *kanji* to provide pronunciation cues. *Furigana* are also used with *kanji* that are difficult or unusual for adults. *Pinyin*, *zhuyin fuhao*, and *furigana* thus all serve the same basic function: they provide a means of pronouncing Chinese characters that the reader does not know. An example lesson from the Chinese, Taiwanese, Japanese, and American first-grade textbooks is shown in Figure 1.

Method

Outline of the Studies

The findings come from three studies. All studies were conducted as part of a larger project on the influence of cultural factors on children's academic achievement.

Study 1. First grade children from Beijing, China, and Chicago were compared on their reading performance. In Beijing, 11 representative schools were selected. Because of the greater heterogeneity of the population in Chicago, 20 schools were chosen to represent the Chicago metropolitan area. Two classrooms within each school were randomly selected. All children in the Chinese classes were tested, yielding a sample of 1023 children. In Chicago, six children (three boys and three girls) were randomly chosen from each of the 40 classrooms. The Chicago sample thus consisted of 240 children. Every child was individually given both word decoding and comprehension tests.

Study 2. First grade children enrolled in 20 classrooms in Taipei, Taiwan; Sendai, Japan; and Minneapolis participated in the study. In each city, two classrooms were chosen at random from 10 schools selected to be representative of the schools in each of the cities. A total of 2,111 children (912 Chinese, 789 Japanese, and 410 American children) were given an individually administered reading test that included knowledge of alphabet (*zhuyin fuhao* in Chinese and *hiragana* in Japanese), word decoding, text comprehension, and reading of text.

| | |
|---|--|
| <p><u>Taipei (Chinese with zhuyin fuhao)</u></p> <p>我: 我: 我: 你: 弟: 送: 做: 爸: 送: 做: 媽: 送: 做: 十: 要: 弟: 給: 一: 爸: 給: 一: 媽: 給: 一: 列: 弟: 條: 出: 爸: 條: 要: 媽: 條: &: 那: 弟: 弟: 船: 海: a; A: 4: 船: 一: 兄: 弟: 坐: 去: 坐: 看: 坐: 一: 去: 去: 禁: 禁: 條: 船:</p> | <p><u>Sendai (Japanese)</u></p> <p>たいていのしんぶんは、大なり小なりを しました。そのときのことをおし して、みんなで、さく文をかくこ しました。 先生が、「これは、ぼんぼり、と きました。さくして、ぼんぼりの文 を きました。」 みんなが、そのあそび 「ついで、いきました。 先生が、「つぎは、こく ぼんぼりに、いきました。」 られ、こくと、はるあそび、 なれ、しらました、こくと、 たりて、お、お、 だ、だ、おれを 大きく、ふりました。 られ、なみの ように、大きく ました、こくと、 ぶん、つぎに とびました、こくと、 ました、い、こくと、 上のものは、あしを ひ、かけたので、ぼんぼりに られ、</p> |
| <p><u>Beijing (Chinese with pinyin)</u></p> <p>18 級 练</p> <p>chén kōng qì hǎo, 早晨空气好, xiǎo xué shēng qǐ de zǎo, 小学生起得早。 zhěng qí pái duì hǎo, 整整齐齐排好队, dà jiā dōu wèi zǎo cāo, 大家都未做早操。 shēn yǎn wān yāo, 伸伸手, 弯弯腰, tiān tiān liàn shēn tǐ hǎo, 天天锻炼身体好。</p> | <p>Chicago (English)</p> <p>The Hat</p> <p>A hat was in the grass. A bug was in the hat. The bug was big! Buffy ran to the hat. Buffy said, "The big hat! The big hat in the grass!" Buffy said, "A big bug! A big bug in the hat!" The hat went up. The bug went up. Buffy and the bug ran.</p> |

Fig. 1. Examples from first-grade reading texts used in Taipei, Sendai, Beijing, and Chicago. *Zhuyin fuhao* notation is on the right of each of the characters in the Taiwan texts and pinyin appears above new or difficult characters in the text from the People's Republic of China. The Chinese text used in Taipei and the Japanese text reads from top to bottom, right to left. The Chinese text used in Beijing, as well as the English text reads from left to right and top to bottom.

Study 3. This study was conducted in Taipei, Taiwan; Sendai, Japan; and Chicago. In Sendai and Taipei, 10 representative schools were selected. The children in Chicago were enrolled in the 20 schools included in Study 1. Within each school, two classrooms were randomly chosen. All 2,763 children in the selected classrooms were given a comprehension test. Six children (three boys and three girls) were randomly chosen from each classroom for an individually administered test of word decoding.

Textbook Analyses, Test Construction and Administration

The construction of culturally fair and appropriate tests is a common problem in comparative research. Translations, even if done assiduously, may be inappropriate because children in one culture may not be familiar with the words used in another culture. Our method of test construction differs from other methods of constructing comparative reading tests in two ways: First, all the tests were constructed simultaneously in two (Study 1) or three (Study 2, 3) languages. Second, we constructed our reading test on the basis of detailed analyses of textbooks used in the cities involved. Two separate analyses of the curricula were conducted: one of the elementary reading textbooks used in Chicago and Beijing, and the other of the textbooks used in Sendai, Taipei, and Minneapolis. We will describe in detail the test construction process for Study 1.

Selecting a textbook was straightforward in Beijing, Taipei, and Sendai because a standardized curriculum is used in each location. In Chicago and Minneapolis, we chose the series used by the largest number of schools in our studies.

Textbook Analyses. The grade and semester level at which each new word was introduced in the textbook was entered into a computer database. Even at this early stage a problem arose that was a function of the different writing systems. The definition of a "word" is straightforward in English, but more difficult in Chinese and Japanese. In Chinese, one character could be a word if it has meaning by itself. The combination of characters becomes a new word on the basis of a derived new meaning. The same character can have different meanings in different words. A word, therefore, is defined as one or more characters that has unique meaning. In English, neither regular forms of the plural of nouns, nor regular conjugations of verbs, such as the past participle, were counted as new words. Irregular plurals (e.g., child to children) or irregular conjugations of verbs (e.g., go to went) were counted as new words.

All words in the English textbooks were entered into a computer database. A dictionary of new words was constructed for Book 1, and each word in the next successive level book of the series was compared to all words in the dictionary. New words thus were defined as those words occurring in

a given text that were not in the dictionary previously. As each new word in the text was encountered, its grade and semester level of introduction was noted automatically. In analyzing the Chinese texts, the words were defined, rewritten in *pinyin*, and entered into the computer, along with the English translation of the words and the grade and semester levels when they were first introduced. This method provided us with a listing of when each word was introduced in the curriculum, as well as a tally of the number of words introduced at each semester level.

From these analyses, we obtained data on the number of words taught throughout the elementary school years in the four cities. Figure 2 shows the number of words introduced in the elementary school reading books in Beijing and Chicago (Study 1). Chinese textbooks contained more unique words than American textbooks for Grades 1 to 3. In the last three years of elementary school, however, American children were exposed to many more new words than were Chinese children.

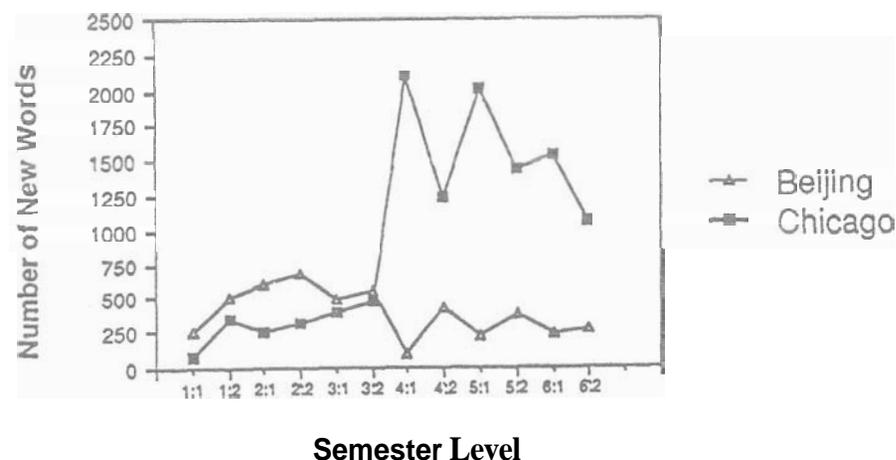


Fig. 2. Number of new words taught every semester in the Beijing and Chicago reading textbooks.

Test Construction. Based on the textbook analyses, we constructed a reading test with two parts: **word** decoding and comprehension. The analysis of the order of introduction of new words provided the basis for our assessment of words common to the two countries. Our original goal in constructing the decoding portion of the test was to include the same words for all countries at each grade and semester level. This proved to be impossible because there were not enough words common to the curricula used in the two countries. Thus, we included some words that were common and some that were **not** common to the two curricula. Ten words were chosen on the basis of frequency of usage from the pool of new

words available at each semester. The tests progressed successively from first grade, first semester through sixth grade, second semester.

The second portion of the test was comprehension. This portion was divided into two subsections: phrase or sentence comprehension, and paragraph comprehension. The phrase and sentence comprehension subsection was included in grades 1 to 3; the paragraph comprehension subsection was included from grades 4 to 6. The same number of new words had to be introduced in the sentences and paragraphs for both countries. The number of words from previous semesters was also taken into account. Grammatical structures were also checked by a bilingual linguist, to ensure that the complexity of the sentences and paragraphs was comparable. We also tried to match the paragraphs thematically as closely as possible. For example, the paragraph used in the second semester of sixth grade in the United States was about the restoration of the Statue of Liberty, and the Chinese paragraph was about the restoration of the Great Wall.

The procedure for constructing the reading tests for Studies 2 and 3 was very similar except that the cumcula in the three languages was considered simultaneously and the design of the tests were marched among the languages at the grade level rather than the semester level.

Test Administration. For Study 1, tests were administered individually to one child at a time. In the word decoding section, children were asked to read aloud the words presented. In the section testing comprehension of phrase and sentences, children were asked to read the phrase or sentence and then choose the picture from a set of alternatives that best represented the idea or action described in the phrase or sentence. Once children started the section for a semester level, they proceeded through all the test items for that semester. If a child missed three out of ten words, testing was discontinued. In the paragraph comprehension portion of the test, the child was asked to read paragraphs at each semester level and then answer several questions about their content. Testing was discontinued if a child missed 2 out of 4 comprehension questions at any semester level.

The test administration procedure for Studies 2 and 3 were basically similar, except that the stopping criteria differed from study to study.

Results

Most of our results involve two comparisons: of items at or below children's grade level, and of items above children's grade level. The pattern of results for these two comparisons varies substantially among the four locations. We believe it is likely that characteristics of the different writing systems are partly responsible for these differences.

Figure 3 shows the results for word-decoding for first-graders from Studies 1 and 3. The two graphs depict the percentage of subjects who

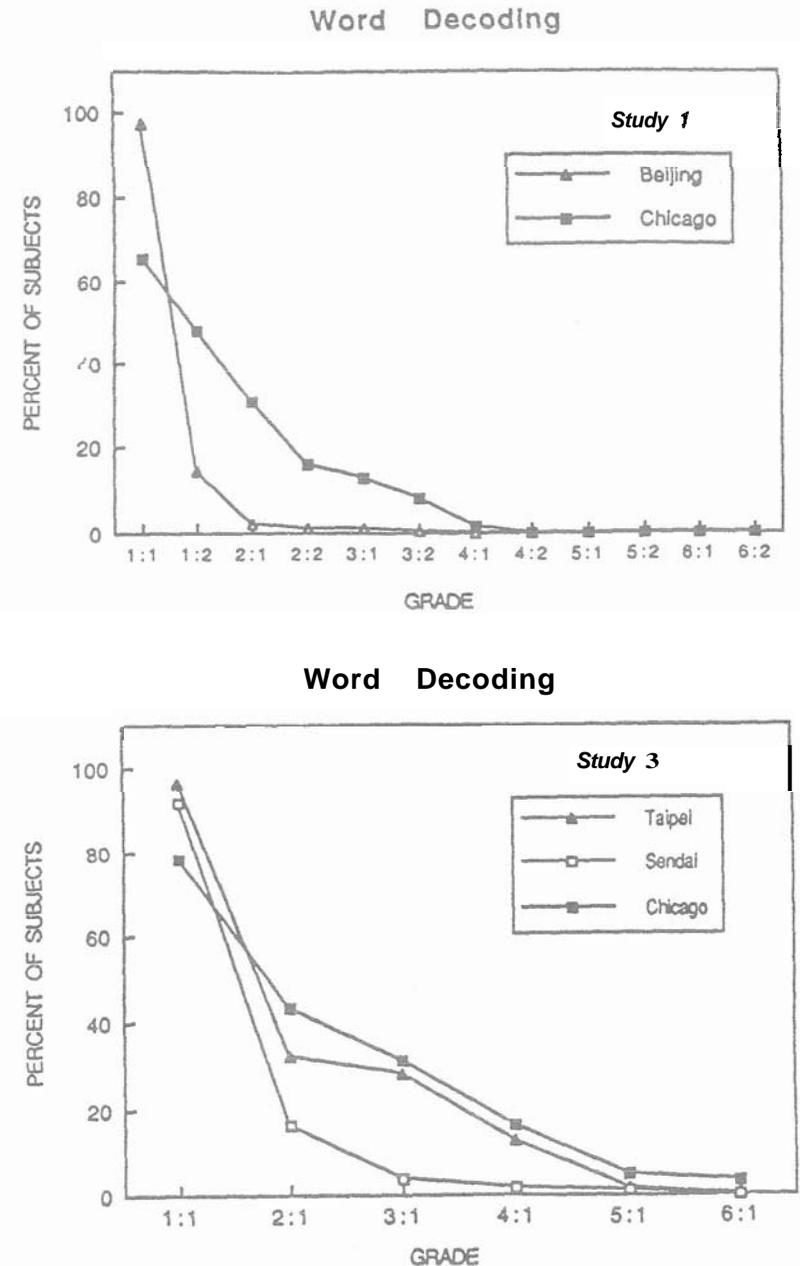


Fig. 3. Percent of subjects completing each level of the word decoding tests for Study 1 and Study 3.

passed each grade level of the tests. The pattern of the results was similar for the two studies. In all cities some children failed to read the words even for the first-semester of the first-grade, and this percentage was substantially higher among the American first-graders than among the Chinese and Japanese first-graders. That is, American children performed worse than children in the other countries when reading words at the first-grade level. Over 90 percent of the children from Sendai, Taipei, and Beijing could read words introduced during the first grade, but less than 80% of the Chicago children could do so. This finding suggests that the commonly held belief that alphabetic languages are more difficult to learn than logographic or syllabic language could be true. However, as the remainder of the graphs show, the pattern of performance was different for decoding words beyond the children's current grade level. In both studies, American children performed much better than the Japanese and Chinese children on words beyond the first-grade level. A higher percentage of American children read words beyond their grade level than did their Chinese and Japanese counterparts.

A similar pattern obtained for the results of the comprehension test (see Figure 4). Almost all of the Chinese children were able to comprehend the first-grade reading material, but only about 80 percent of the American children were able to do so. However, significantly more American than Chinese first-graders were able to comprehend materials beyond their grade level and were able to proceed to later grade levels of the test than were their Chinese counterparts.

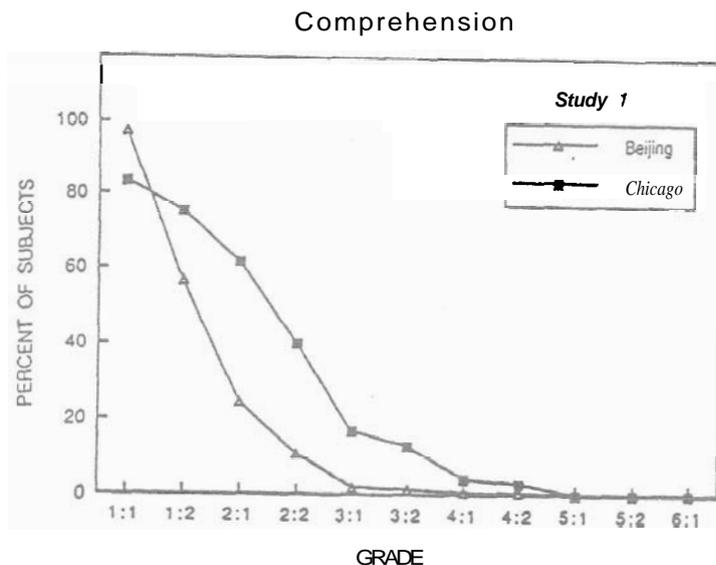


Fig. 4. Percent of subjects completing each level of the comprehension test for Study 1

Another way to examine these results is to compare the performance of children who actually continued the tests to the higher grade and semester levels. Figure 5 shows the performance of children from Study 2 on the word decoding test at each grade level. American children performed less well than the Chinese and Japanese children on the first-grade level words. However, for reading words beyond their grade level, American children performed significantly better than the Chinese and Japanese children. Similar results are shown in Figure 6 for the comprehension test from Study 1 at each semester and grade level. Chinese children did better than American children on questions at the semester level in which they are enrolled. But beyond their current semester level, American children performed at a higher level than Chinese children.

To assess further the relative pattern of performance on the comprehension tests, we examined children's ability to decode the key words in each paragraph. The key words were those that were introduced in the textbook at the target level for the paragraph. This analysis allowed us to assess whether children's failures in comprehension resulted simply from an inability to read words that were critical to abstracting the meaning of the paragraphs and questions, or from generally poor comprehension skills. As shown in Figure 7, the pattern of results for these key words is very similar to that for the decoding words: American children do less well on the key words at their current semester level, but American children are able to read significantly more key words beyond their grade level than their

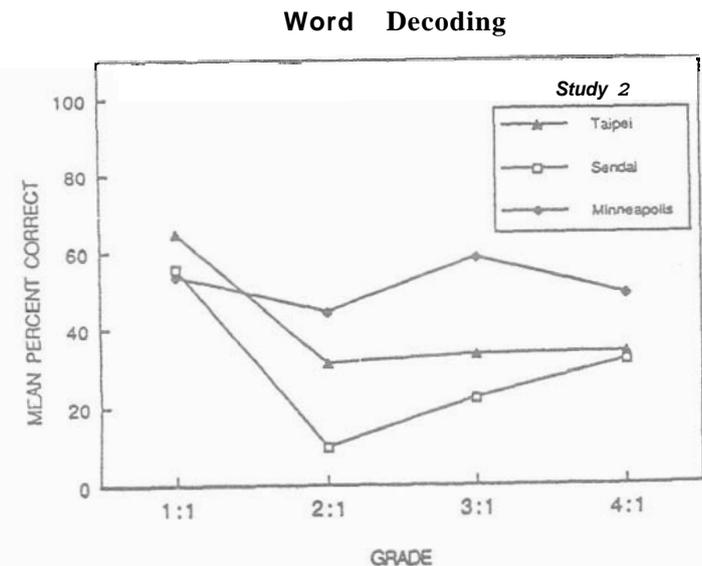


Fig. 5. Average percent of correctness on word decoding test of children at various levels of reading skills.

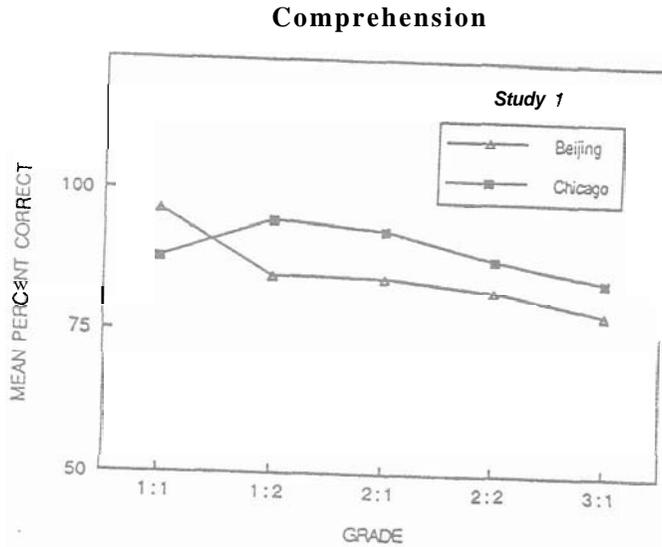


Fig. 6. Average percent of correctness on comprehension test of children at various levels of reading skills.

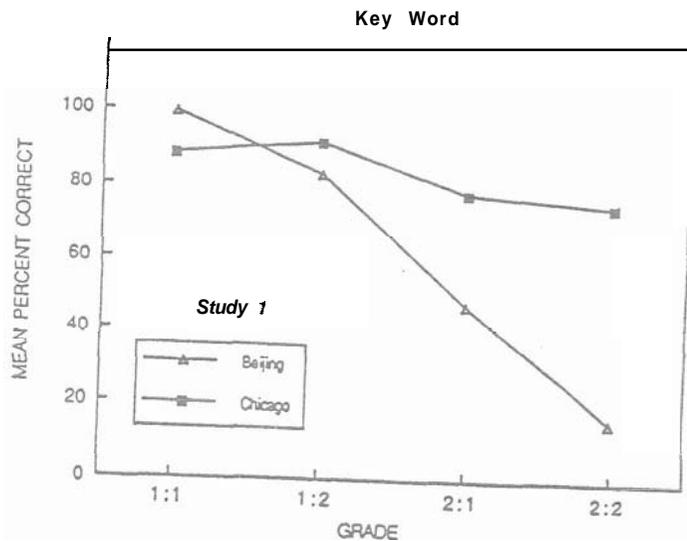


Fig. 7. Average percent of correctness on decoding the key words of children at various levels of reading skills.

Chinese counterparts. American children thus were more likely to be able to answer comprehension questions beyond their grade level.

The pattern of the results cannot be attributed solely to the characteristics of a single test. Our results are based on three different reading tests that were given to large samples of children in five locations. For both word decoding and reading comprehension, consistent findings were shown that American first-graders, on average, did less well on reading material at their current grade level than did the Chinese and Japanese first-graders. But a substantially greater proportion of the American children were able to read materials beyond their current grade or semester level. In addition, those American children who were able to read beyond their grade level were able to read at a higher level than their Chinese and Japanese counterparts.

Explanation of the Cross-Over Interaction. What accounts for the consistent findings that American children were better able to read words beyond their grade level? This could be the direct result of the orthography. Once children have mastered the basic letter-to-sound rules of English orthography, they can make good guesses at the sounds of words they have not previously encountered. Children who learn to read Chinese characters or Japanese *kanji* do not have this advantage.

Another important aspect of the data is the relatively poor performance of American children for words at their current grade level. One could argue that this difference also reflects the characteristics of the English writing system. Perhaps a certain percentage of children learning to read English simply fail to understand the code of grapheme-phoneme correspondence. While this may be true, it seems worthwhile to examine the characteristics of the distribution of the reading scores in the Chicago first-grade sample. As shown in Figure 8, the total range of the mean scores for each classroom in comprehension scores is much wider in Chicago than in Taipei or Sendai for Study 3. A comparable pattern of results was found for comparisons of children in Chicago and Beijing in Study 1.

We believe that the broad distribution of American scores could be related both to the characteristics of the tasks encountered by American children learning to read English, and the educational practices for handling slow and fast readers in the American classrooms. In other words, the American sample contained both more poor readers and more good readers. Poor readers have difficulty reading any words, but the good readers are able to read words even several semesters beyond their current grade level. In contrast, the Chinese and Japanese samples have fewer children at either end of the distribution of reading performance. The distribution of scores from Study 2 supports this contention. We counted the number of children from each city who received the highest and the lowest 100 scores from all three cities and combined the results. If children from the three cities performed equally well in reading, approximately 33 children from each

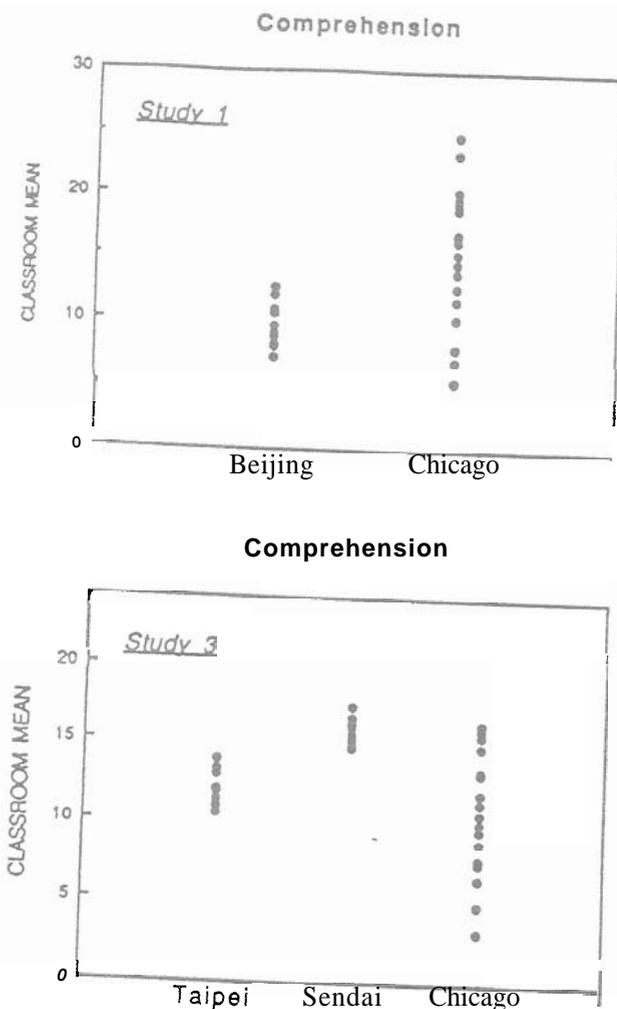


Fig. 8. Mean Scores on the comprehension tests for each school in Beijing and Chicago (Study 1), and Taipei, Sendai, and Chicago (Study 3).

city should be among those obtaining the top and bottom scores. In fact, American children were overrepresented in both groups. Fifty-eight American children were among the 100 first graders with the lowest scores in reading performance and 40 American children were among the top 100 children with the highest scores in reading scores. We believe that the greater number of poor readers in the American sample could be partly responsible for the finding that fewer American children were able to read words at their grade level. Similarly, the greater number of good reader.

in the American sample could be partly responsible for the finding that more American children were able to read words beyond their grade level.

The results suggest that some American children may have difficulty with the initial stages of reading English. We cannot say for sure if this is an independent effect of orthography, but it is important to consider the characteristics of English per se before generalizing to all alphabetic languages. Several researchers have demonstrated that the initial acquisition of decoding skills is faster in children learning to read highly regular alphabetic systems, such as Turkish (Oney and Goldman, 1984) or Finnish (Kyostio, 1980). Regularity in English orthography is found at the morphophonetic level, not at the phonetic level. Thus, English cannot be learned as a set of simple writing-to-sound rules. It is important not to allow these difficulties to bias our interpretation of the relative difficulty of learning to read all alphabetic languages. English appears to be a relatively difficult language in which to gain an understanding of the grapheme-to-phoneme code. An interesting question for further research is whether the cross-over interaction that we have shown in the patterns of American children's reading achievement patterns would also be found in cultures that use more regular alphabetic orthographies.

Discussion

Our results reveal that the relation between orthography and the acquisition of literacy is more complex than has been assumed previously. The earliest acquisition of reading skills may depend strongly on phonemic awareness and segmentation skills involved in learning an alphabetic language; these skills may be relatively unimportant when learning to read a logographic language. Once the initial principle of grapheme-to-phoneme correspondence is mastered, however, the alphabetic language may offer a significant advantage. The ability to sound out words allows children reading an alphabetic language to guess the sounds of words they have not encountered before. In contrast to the suggestion of some researchers (e.g., Gleitman and Rozin, 1977), our data provide no indication that learning to read is easier when the child learns to read a non-alphabetic language. In fact, the absence of a means of sounding out characters means that pronunciation of new words is a common problem for the Chinese and the Japanese readers.

An additional advantage of an alphabetic system concerns the acquisition of new word meanings from context. There is evidence (e.g., Nagy, Anderson, and Herman, 1987) that this is an important factor in the acquisition of new vocabulary words once children acquire basic decoding skills. Even if children cannot pronounce a word completely, they still can use the contextual and previous information as cues to deduce the word's meaning. But this is much more difficult or even impossible when reading

a logographic writing system. Guessing the meaning of the word from context becomes much more difficult when the possibility of sounding out the word is reduced. Thus, the greater possibility of deriving the meaning of a word from context is another positive advantage of an alphabetic writing system.

The Importance of Instruction. Our results also show that it is important to consider the role of curriculum and instruction when considering differences in achievement patterns in countries that use different orthographies. Children in all Asian countries did better than American children on words at their current grade level. This finding is similar to comparable studies of mathematics achievement (Bartsch and Fang, 1987; Stigler *et al.*, 1982). The probability that children will actually learn the concepts included in the curricula is much higher in Japanese and Chinese than in American schools.

One can, in fact, interpret the results as an interaction between the nature of the orthography and the nature of the curriculum and instructions. For the Chinese first-graders, learning characters is the primary task of learning to read. For American children, however, the task is not simply learning words; they must learn the rules of their orthography. Perhaps it is not surprising, then, to learn that the Chinese curriculum contains more than twice as many words in first grade as the American curriculum. Thus, our results do not constitute a criticism of the Chinese curriculum or teaching methods. The nature of Chinese orthography dictates that instruction is critical in the acquisition of new words, and the design of the Chinese curriculum appears to reflect this fact.

Conclusion. Our results indicate that attempts to characterize different writing systems as easy or difficult to learn may not capture all of the influences of the writing system. Each writing system has both easy and difficult features. The ways that these languages are taught, and the patterns of achievement that we have found, reflect different aspects of the writing systems. Just as early cross-cultural research failed in its attempts to describe cultures as more or less primitive, we believe that attempts to describe writing systems along a simple continuum of difficulty are inadequate. What is needed instead is detailed analyses of the tasks that the child faces in learning a particular language.

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