A Study of Chinese Students' Chinese/English Decoding Strategies

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This study is an investigation of the effects of writing systems on Chinese subjects' decoding strategies in both Chinese and English. Subjects' length of residence in the U.S. was considered as the environmental effect on subjects' use of strategies on decoding Chinese and English words. Test materials include short-term memory word-recognition tests and long-term memory cued-recall tests. Following one-by-one interviews were conducted. Seventeen Chinese subjects and 8 American subjects participated in this study. The study results suggest that both writing systems and learning environment are significant factors to subjects' application of graphic, phonological or semantic strategies in decoding Chinese and English words.

Introduction

Orthographies are classified into three main categories, alphabetic, ideographic and syllabic according to their forms and linguistic characteristics (Henderson, 1992). Most European languages, including English, are alphabetic languages. Mandarin Chinese and Japanese Kanji are ideographic languages. Japanese Kana is a syllabic language. In alphabetic languages, spoken language is presented at the phoneme level. In ideographic languages, each ideograph represents a unit of meaning, generally, a word or a morpheme. In syllabic languages, each symbol represents a syllable. It is believed that an ideographic language tends to be more meaning-based; while an alphabetic language tends to be more sound-based. Therefore, the process of reading Chinese characters may differ from that of reading words written in an alphabetic language such as English. Makita (1968) found that a Chinese character is a symbol
grasped with the total perception of its figure at one sight, the perception being directly linked to the meaning represented by that symbol and the pronunciation being deduced from the comprehension of its meaning. In reading Chinese characters, a total visual perception of the symbol is primarily connected with its meaning, and how it is pronounced becomes secondary (e.g., Hung & Tzeng, 1981; Hung et al, 1988). However, in English, phonology and orthography are closely related. In reading an English word, the visual perception of a symbol is primarily connected with its pronunciation and its meaning is derived from auditory decoding (e.g., Conrad, 1964; Kuo, 1981; Denbow, 1988).

Few studies have considered reading difficulties of learners whose first language writing system differs from that of English. This study is an investigation of the effects of writing systems on Chinese students' semantic, phonetic, and graphic decoding strategies in reading Chinese (L1) and English (L2). The term "decoding" is defined as the process of translating letters or symbols into comprehensible language. Graphic strategies refer to the methods of decoding words by their orthographic structure, e.g., spelling and form. Phonological strategies are defined as the methods of decoding words by their speech codes, e.g., phonetics, sound, and pronunciation. And semantic strategies refer to the methods of decoding words by their semantic codes, e.g., meaning.

Furthermore, the variable of subjects' length of residence in an English speaking environment (the U.S.) might be a factor which influences reader's use of reading strategies. Therefore, this study also examines to what extent Chinese subjects' length of time staying in the U.S. affects their application of decoding strategies in reading Chinese and English words.

The Previous Studies

Some researchers have investigated the comparative study of reading strategies between L1 and L2. Chu-Chang & Loritz (1977) compared the English phonological coding between 22 Cantonese-speaking Chinese ESL students and Spanish ESL learners. They found
that both types of ESL learners applied more visual strategies on English word-recognition tests. Shwedel (1983) examined whether Chinese students adopted phonological strategies from an alphabetic language, English, to read Chinese. The results suggested that skilled readers of Chinese, college students, were more likely to use phonological codes than visual codes to store information on Chinese cued-recall tests. However, the less skilled readers, workers, with low alphabetic knowledge tended to use either strategy. Shwedel concluded that phonological recoding was not intrinsic to reading text in the Chinese system. Koda (1989) investigated first language (L1) orthographic impact on cognition processing involved in second language (L2) reading. The results show that regardless of the language backgrounds, the four orthographically diverse groups (Arabic, English, Japanese, and Spanish) dominantly applied phonological strategies on word-recognition tests. However, the phonological (Arabic, English, & Spanish) readers applied a larger degree of phonological coding strategies than morphographic (Japanese) readers. This evidence show that strategy transfer should be observable in L2 reading.

Haynes (1989) was interested in finding out whether a reader's greater sensitivity to English "orthographic regularity" (systematic sequencing of letters) was significantly associated with reading success. Haynes found that L1 readers were more efficient at orthographic matching than either freshmen or senior college L2 readers. Orthographic sensitivity correlated with comprehension, not speed, and was significantly associated with word learning. Haynes concluded that orthographic knowledge is related to L2 readers' success in reading English texts. Hayes (1988) investigated how native and non-native Chinese readers identified Chinese words. He was interested in finding out: 1) How are Chinese symbols read during silent reading? and 2) Is one strategy (semantic, graphic, or phonetic) predominantly used by native or non-native speakers? The result showed that, at the word level word recognition, Chinese readers made significantly more phonological errors than either graphic or semantic errors. The American readers used a mixed strategy of phonological and graphic processing.
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Shwedel, Hayes, Koda, and Haynes used only adult subjects at one level, it is not clear whether learner's length of time exposing to an English speaking environment influences their reliance on phonological, graphic, and semantic processes or not. Furthermore, most experimental tests have been done only in Chinese or only in English; I am interested in giving subjects both English and Chinese tasks and making a comparison of their decoding strategies in these two different orthographies. This study is also designed to explore the extent to which the degree of transference varies with readers' length of residence in an English speaking environment.

Methodology

(1). Research questions

Two research questions are addressed in this study: 1) To what extent do Chinese students process words semantically, graphically, and phonologically in their native language (Chinese) as compared with their learning of English (L2)? and 2) Does the length of time that Chinese students have been in an English speaking environment (e.g. the U.S.) influence their application of semantic, phonetic, and graphic decoding strategies in decoding Chinese (L1) and English (L2)?

(2). Subjects

Subjects were 17 Chinese students from Taiwan who studied at the graduate school of the University of Minnesota. Their average age was 28.3 and average length of time staying in the U.S. was 4.9 years. They were all native speakers of Chinese and had learned English for an average of 15 years. Eight American graduate students at the University of Minnesota served as the control group. Their average age was 43.3 and they had lived in the U.S. for an average of 40.9 years.

(3). Materials

In this study, there are two test tasks - short-term memory (STM) word-recognition tests and long-term memory (LTM) cued-recall tests.
It is important to distinguish between short- and long-term memory tasks. Short-term memory is a repository of currently activated information; the brain holds two to eight familiar units of memory, known as chunks, and the duration of information holding is about 18 to 30 seconds. The retrieval of information in short-term memory is easy and fast; however, the information can easily decay or be interfered with (Sawyer & Butler, 1991). In contrast to short-term memory, long-term memory has no restriction on its information capacity and information can be held there indefinitely. There is little evidence of information loss; however, the retrieval of information may take some effort and may be slow (Gathercole & Baddeley, 1993). Therefore, in this study, the word-recognition tests contribute to short-term memory tasks and cued-recall tests contribute to long-term memory tasks.

The short-term memory word-recognition test was adopted from Hayes’ experiment. Subjects were presented with ten different slides, each with six random single characters. Each slide was on view for four seconds, followed by a response period of 10 seconds, in which subjects, using a response booklet, circled the characters which they thought they had seen on the slide. There were phonological, graphic, and semantic distracters randomly dispersed throughout each response to each slide. For example, on the Chinese word-recognition test, there were six words presented on the slide, i.e., 兄因加青走水. The subjects’ task was to circle what they had seen in the response booklets as follows: 兄走佳兄因. An example of the English word-recognition test was one desk right half dime egg on the slide and dime won disk egg half in the response booklet.

The long-term memory cued-recall test was adopted from Shwedel’s experiment. There were both Chinese and English versions. The testing session included three trials, phonetically-similar pairs, semantically-similar pairs, and graphically-similar pairs. For each trial, ten pairs of words were presented at the rate of one every three seconds. From the list of each trial, the first word served as a probe. After the last pair of words on the list were presented, the probe word of each pair was shown and subjects tried to write down the word which had followed it.
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within five seconds. For example, on the Chinese cued-recall test dealing with graphically similar pairs, the subjects read ten pairs of Chinese characters, i.e., $\text{字 字}$. After that, the probe word of each pair was shown on the slide, i.e., $\text{字}$. The subjects' task was to write down the word with which it had been paired $\text{字}$. An example of English graphically similar pairs might be doll golf; then the probe word golf was shown on the slide. The subjects' task was to write down the word with which it had been paired doll.

In addition, the author had individual interviews with some of the subjects after they had taken the Chinese/English tasks. There were recorded for qualitative analysis. The author tried to elicit how learners' past language experiences and their language learning strategies were related to their errors made on the tests, and to understand their own explanation of the errors. All the interview questions were open-ended questions. An example is: "When you were doing word-recognition tests, which strategies did you apply the most to help yourself memorize the words shown on the slide?" The purpose of the individual interview was to validate the test results and to yield more information for analysis.

(4) Procedures
The Chinese subjects took the tests in a lobby of the school's library. They took the Chinese tests first and then the English tests. The task lasted for one hour. Three one-by-one interviews were done; each took half an hour. All the interviews were recorded. The American subjects only took the English tests during their usual class time of a research seminar course. The task lasted for half an hour.

(5) Scoring/Design
Word-recognition tests were scored by the number of graphic, semantic, or phonological distractors that subjects circled on the response booklets. In each test, there was a total of 10 graphic distractors, 10 phonological distractors, and 10 semantic distractors. Thus, the highest number of errors that a subject might make on a word-recognition test for each strategy was 10. The criterion used in
In this study, the independent variable was the use of strategies - the semantic, the graphic, or the phonological decoding strategies. The dependent variable was the number of errors on the word-recognition tests and the total performance on the cued-recall tests. Descriptive statistics are presented first, followed by a two-way analysis of variance (ANOVA) and one-way ANOVA. Follow-up t-tests were done for each analysis to find out whether the semantic, graphic, or phonological variables were more strongly correlated with the word recognition or cued-recall abilities. All the data analyses were conducted with SPSS/PC statistic program. The significance level was set at $P = 0.05$. Furthermore, test reliability and test item discrimination were computed by using the TESTAT. The results of the interviews were analyzed in detail in order to yield more information for qualitative analysis.
# Results

(1) Word-Recognition Tests

Table 1: Means and Standard Deviations of Word-Recognition Tests

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Chinese Subjects</th>
<th>American Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-year in the U.S. (N=6)</td>
<td>2-4 years in the U.S. (N=6)</td>
</tr>
<tr>
<td>Chinese Word-Recognition Tests</td>
<td>Graphic Errors</td>
<td>Phonological Errors</td>
</tr>
<tr>
<td>M</td>
<td>1.40</td>
<td>6.20</td>
</tr>
<tr>
<td>SD</td>
<td>0.89</td>
<td>1.79</td>
</tr>
</tbody>
</table>

| M                | 1.17             | 5.67              | 0.20             | 1.17          | 1.83            | 0.33             |
| SD               | 1.17             | 2.50              | 0.41             | 0.41          | 1.33            | 0.82             |

English Word-Recognition Tests

| M                | 1.70             | 1.33              | 0.50             | 0.82          | 1.69            | 0.38             |
| SD               | 1.17             | 1.60              | 0.83             | 0.83          | 0.74            | 0.74             |

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First, to test whether Chinese subjects apply different decoding strategies on reading and memorizing English and Chinese words on
word-recognition tests, a two-way ANOVA was conducted. The results show that there is a significant main effect for the factor, writing systems (Chinese/English), (F(1, 96) = 24.55, P = 0.000). The main effect for the factor, strategies, is significant as well (F(2, 96) = 82.54, P = 0.000). The results demonstrate that Chinese subjects applied significantly different strategies in decoding Chinese and English words on word-recognition tests. The results from one-way ANOVA show that Chinese subjects placed more emphasis on phonological strategies on both STM English and Chinese word-recognition tests. However, Chinese subjects had a heavier degree of emphasis on phonological strategies on Chinese word-recognition tests than on English word-recognition tests.

In order to test whether Chinese subjects’ use of strategies in decoding English words on word-recognition tests vary with their length of time exposed to the target society (the U.S.), a two-way ANOVA was conducted. The results from testing the three Chinese groups show that there is a significant main effect for the factor, strategies (F(2, 42) = 55.92, P = 0.000). However, there is no significant effect for the factor, groups (F(2, 42) = 0.16, P = 0.851). The follow-up t-tests show that subjects, among the three groups, apply more phonological strategies than other strategies in decoding English words; however, subjects’ length of time exposed to the English speaking environment doesn’t affect their semantic, graphic, or phonological strategies on STM English word-recognition tests.

To compare the strategies used by the Chinese and American subjects on English word-recognition tests, a two-way ANOVA was conducted. The results showed that there is a significant main effect for the factor, strategies, (F(2, 69) = 11.07, P = 0.000). However, there is no significant effect for the factor, groups (F(1, 68) = 0.13, P = 0.720). The follow-up t-tests show that both Chinese and American subjects apply more phonological strategies than other strategies on STM English word-recognition tests. However, there is no significant difference between Chinese and American subjects' application of semantic, graphic, and phonological strategies on English word-recognition tests.
Table 2: Means and Standard Deviations of Cued-Recall Tests

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Chinese Subjects</th>
<th>American Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-year in the U.S.</td>
<td>2-4 years in the U.S.</td>
</tr>
<tr>
<td></td>
<td>(N=6)</td>
<td>(N=6)</td>
</tr>
<tr>
<td>Chinese Cued-Recall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphically-Similar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>94.00</td>
<td>93.33</td>
</tr>
<tr>
<td>SD</td>
<td>5.48</td>
<td>8.17</td>
</tr>
<tr>
<td>Phonological-Similar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>88.00</td>
<td>93.33</td>
</tr>
<tr>
<td>SD</td>
<td>17.89</td>
<td>8.17</td>
</tr>
<tr>
<td>Semantically-Similar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>92.00</td>
<td>100.00</td>
</tr>
<tr>
<td>SD</td>
<td>13.04</td>
<td>0.00</td>
</tr>
<tr>
<td>English Cued Recall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphically-Similar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>80.00</td>
<td>76.67</td>
</tr>
<tr>
<td>SD</td>
<td>7.07</td>
<td>23.38</td>
</tr>
</tbody>
</table>
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Phonological
-Similar
M    78.00  86.67  100.00  100.00  
SD   22.80  12.11  0.00    0.00  
Semantically
-Similar
M    94.00  93.33  96.67  92.50  
SD   13.42  10.33  8.17   8.86  

Figure 3: Chinese Cued-Recall Tests by Chinese Groups

Group 1: 1-year in the U.S. Group 2: 2-4 years in the U.S. Group 3: 5 or more years in the U.S.
To test whether Chinese subjects apply different decoding strategies on memorizing Chinese and English words on LTM cued-recall tests, a two-way ANOVA was conducted. The results show that there is a significant main effect for the factor, writing systems (Chinese/English) \( F(1,96)=7.35, P=0.008 \). The main effect for the factor, strategies, is significant as well \( F(2, 96)=3.37, P=0.039 \). The results demonstrate that Chinese subjects applied significantly different strategies in decoding Chinese and English words on cued-recall tests. The results from one-way ANOVA show that Chinese subjects applied more semantic strategies than other strategies on both Chinese and English cued-recall tests. However, Chinese subjects performed significantly better on Chinese cued-recall tests than on English cued-recall tests.

In order to test whether Chinese subjects’ use of strategies in decoding English words on cued-recall tests vary with their length of time exposed to the target society (the U.S.), a two-way ANOVA was conducted. The results from testing the three Chinese groups show that there is a significant main effect for the factor, strategies \( F(2,42)=3.30, P=0.047 \). The main effect for the factor, groups, is significant as well \( F(2,42)=4.13, P=0.023 \). The follow-up t-tests show that subjects, among the three groups, apply more semantic strategies than other
strategies in decoding English words. Subjects' length of time exposed to the English-speaking environment does affect their degree of emphasis on semantic, graphic, and phonological strategies on LTM cued-recall tests. Chinese subjects, with their increased length of time in the U.S., had a heavier degree of emphasis on phonological strategies on LTM cued-recall tests.

To compare the strategies used by Chinese and American subjects on LTM cued-recall tests, a two-way ANOVA was conducted. The results show that there is a significant main effect for the factor, strategies (F(2,69) = 5.93; P = 0.04). However, there is no significant main effect for the factor, groups (F(1,69) = 0.34, P = 0.56). The follow-up t-tests show that Chinese subjects applied more semantic strategies than other strategies on LTM English cued-recall tests; however, American subjects applied more phonological strategies on English cued-recall tests.

Discussion

The results echoed these two research questions proposed in this study. First, Chinese learners did apply significantly different strategies in reading Chinese L1 and English L2. Though Chinese subjects dominantly applied phonological strategies on both Chinese and English word-recognition tests, the degree of emphasis on phonological codes is significantly different (Chinese > English). However, Chinese subjects applied more semantic than graphic or phonological strategies on both LTM Chinese and English cued-recall tests.

On STM word-recognition tests, the test results were consistent with Hayes' (1989) study which showed that Chinese readers made more phonological errors than graphic or semantic errors on Chinese word-recognition tests. However, the results contradict Chu-Chang & Loritz's (1977) study in which they suggested that ESL learners applied more visual strategies on English word-recognition tests. This difference
might be due to the subjects' various length of English study. On Chu-Chang & Loritz's study, they had children ESL learners, while in this study the subjects were adult ESL learners. Subjects' length of English study might be a variable for such a kind of study.

On LTM cued-recall tests, the test results contradict Shwedel's (1987) study which showed that skilled readers of Chinese were more likely to use phonological codes than visual codes to store information on Chinese cued-recall tests. The difference might be due to Shwedel's subjects from Hong Kong where they had more chance to have sound input of English compared to the subjects from Taiwan. Subjects' length of residence in an English speaking environment might be another variable for this kind of study.

Second, Chinese subjects' length of residence in the U.S. does not significantly influence their application of strategies on Chinese and English word-recognition tests, and Chinese cued-recall tests, but on English cued-recall tests, the situation is quite different. With the increasing number of years staying in an English-speaking environment, Chinese subjects tended to rely more on phonological strategies in memorizing the English similar pairs on cued-recall tests. One possible explanation for this could be that the environmental input had an effect on Chinese subjects' recall of English words. Another finding is also very interesting. Although the results show that Chinese subjects had no significant difference on their application of strategies on English word-recognition tests with their various length of time exposed to an English-speaking environment, the mean scores of phonological errors on English word-recognition tests did show their various emphasis on phonological strategies. With the increase in number of years in the U.S., subjects' phonological errors decreased. It may be that the environmental input had more effects on the newly arrived students than on the other students.

As compared to the native English speakers, American subjects, who had more phonological emphasis on both English word recognition tests and cued-recall tests, Chinese subjects had heavier emphasis on phonological codes on both STM Chinese and English
word-recognition tests, but still had more reliance on semantic strategies on LTM English cued-recall tests than they did on Chinese cued-recall tests. As we mentioned above that English is an alphabetic language, it is reasonable for American subjects to dominantly apply phonological strategies on both STM English word-recognition tests and LTM English cued-recall tests. However, for the Chinese subjects, although they were used to memorizing Chinese characters by their graphic and semantic features, they still applied more semantic strategies rather than phonological strategies in memorizing English words in long-term memory. These results were consistent with Koda’s (1989) study which suggested that strategy transfer should be observable in L2 reading. The effects of writing systems on L1 and L2/FL decoding are evident too.

The more valuable data was from the one-by-one interviews. One subject from the 1-year group said that as a science major, she used to think about things by reasoning. She explained that when she took the cued-recall tests, she read the word first and then pictured the word in her mind. For example, in seeing the graphically-similar pairs, "grown/crown", she pictured the "crown" in her mind, then when she saw the probe word "grown", she connected "grown" with the picture "crown" together and got the correct recall.

One subject from the 2-4-year group said that in taking the word-recognition tests, he felt it was easier to read the words out and then memorize them. But on the cued-recall tests, he noticed that since there were more homonyms in Chinese, it would be difficult to memorize the sounds and then recall them. Therefore, the meaning of words would be easier to remember than their shapes and sounds. He emphasized that using sounds was the quickest way to memorize the words and using meaning was the most accurate way to memorize the words, both in Chinese and in English. His difficulty was that the unfamiliar English words were hard to pronounce. Under such conditions, graphic strategies were used instead of phonological. The other problem he found was that in memorizing the sound he was more likely to spell the word incorrectly in English but not in Chinese. Since in English one or two letters can contribute to one sound, the same sound could consist of
different spellings. He also indicated that he still used methods which he had obtained in learning Chinese to learn English. In other words, he memorized English words' spelling and meaning first, and then tried to pronounce them. This learning style was quite different from American native speakers', since they learned how to speak English orally first, then learn the meaning of a word, and finally learned how to spell it. He pointed out that if English education programs in Taiwan could first teach students how to pronounce the words, then emphasize their spellings and meanings, Taiwanese students would probably learn English more easily.

Another subject from the 5 or more-year group said that performing well on these tests depended on one's training in school. If the school had trained students to learn words by their similar sounds, meanings, and shapes, they would have felt more confident in taking these tests. He recalled that he had had this kind of training in learning Chinese but not in learning English. Additionally, he explained that the learning environment was very important. He rarely had a chance to speak English in Taiwan, but after he came to the U.S., he had more aural input and spoke English more often. This might influence his use of phonological strategies in reading both Chinese and English. He also suggested that if Taiwanese students could start to learn English early on in elementary school instead of in high school, they would find it easier to adjust themselves to the linguistic variance of languages. The data showed that Chinese subjects' number of years staying in a totally English-speaking environment and their educational background were important variables related to their use of strategies in reading both Chinese and English.

Conclusion

L1 and L2 transference is observable in most language learners. Most empirical research has investigated transference from L1 to L2; however this study research was conducted to look at both sides of transference - from L1 to L2 and from L2 to L1. Results showed that Chinese subjects transferred their L1 reading strategies, particular
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semantic ones to L2 on long-term memory recall tests. However, whether Chinese subjects transfer their phonological codes from L2 to L1 on short-term memory word-recognition tests is not yet definite. Since all the subjects were adult learners, we do not know whether younger learners would also rely more on phonological strategies on Chinese word-recognition or not. Further research should be done to see what happens with beginning EFL learners especially children.

Second, most research findings suggest that Chinese subjects predominantly used phonological strategies rather than other strategies in reading Chinese words. We should keep in mind that Chinese subjects used different strategies on word-recognition and cued-recall tests. On word-recognition tests, the use of phonological strategies was apparent. However, on cued-recall tests, the use of semantic strategies was more dominant. We could not generalize the results just from one test result. The difference between short-term memory and long-term memory tests should be considered. Furthermore, subjects' language background and length of language study should be taken into consideration, too. We can conclude from this study that: 1) American readers place heavier emphasis on phonological codes on both STM English word-recognition tests and LTM English cued-recall tests, 2) adult Chinese ESL learners had more phonological code emphasis on STM Chinese and English word-recognition tests, but they place more semantic code emphasis on LTM Chinese and English cued-recall tests, and 3) the English-speaking environment has effects on Chinese subjects' use of phonological strategies on decoding English words.

A limitation of this study is the number of subjects. This study only had 25 subjects. In a statistical study, the number of subjects should be considered. A study with too few subjects cannot draw powerful conclusions. In this study, all the American subjects were graduate students in a linguistics seminar course, who were more knowledgeable about linguistic differences between languages than typical native English speakers. For future research, it would be better to select American subjects from undergraduates outside of any language field. Furthermore, this study only used adult subjects; further research may focus on beginning EFL learners especially children, and intermediate
EFL learners, and look at how these learners transfer and develop their
graphic, semantic, and phonological strategies in Chinese L1 and English
L2/FL.

Nevertheless, this study points out that different writing systems
require readers to apply different decoding strategies. The sound input
from an English speaking environment cannot be ignored, either. Since
English is a phonological language, the role of sound should be taken
into careful consideration when teachers teach English to EFL learners
whose learning environment lacks English speaking and listening
stimuli.

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