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# Lower-Level Processing Skills in English-as-a-Second-Language Reading Comprehension: Possible Influence of First Language Orthography

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***Abstract***

*Cross-linguistic studies on second language (L2) reading reveal that component skills of reading such as word recognition, phonemic decoding, spelling, and oral text reading are prone to the influence of first language (L1) orthography but few empirical studies have examined the possible influence of L1 orthography on these skills. This study investigates how adult ESL learners of two different L1 backgrounds (Spanish and Chinese) compare in their performances on word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency and how these skills are related to their overall ability in reading comprehension. The differences in the learners' performances on the component skills and the variations in the role of these skills in ESL reading comprehension indicated possible influence of the orthographic features of learners' first language.*

***Keywords***

*second language reading comprehension, spelling, word recognition, phonemic decoding, oral text reading, first language orthography*

## 1. Introduction

Reading is a dynamic and complex process in which readers actively construct meaning from a text. This process requires coordination between various component skills which are often categorized into lower-level and higher-level processes (Grabe, 2009; Koda, 1992; Nassaji, 2003). Lower-level processing involves basic decoding of print and encoding of visual configurations, such as skills in letter identification, word recognition, syntactic parsing, and proposition encoding (Nassaji, 2003; Yamashita, 2013), while higher-level processing involves syntactic, semantic, and discourse knowledge and skills in building text representation, "integrating information within a text, activating and utilizing background knowledge in text meaning construction, making elaborative inferences, monitoring comprehension, and strategic processing" (Yamashita, 2013, p. 52). Although there has been ongoing research examining the relative importance of each level of processing in L2 reading comprehension, it has been commonly agreed that both levels of processing play a significant role in fluent reading and information at one level of processing compensates for deficiencies at the other level of processing. Because operations of various reading-related components draw on the limited capacity of our cognitive resources (Perfetti, 1985; Samuels, 2006; Stanovich, 1980), compensation occurs at the expense of cognitive capacity and constitutes an extra burden on the reader's attentional resources. For example, deficiencies in lower-level word recognition and grapho-phonemic processing can be compensated by higher-level knowledge sources at the expense of cognitive resources, which will result in few resources left for comprehension processes.

Because lower-level processes inform the operations of high-level processes, inefficiency in lower-level processes may lead to lack of success in passage-level reading comprehension. The importance of lower-level word recognition and grapho-phonemic processing has led to a growing number of studies in L2 reading (e.g., Geva & Siegel, 2000; Geva, Wade-Woolley, & Shany, 1997; Gottardo, Yan, Siegel, & Wade-Woolley, 2001). Meanwhile, word recognition and grapho-phonemic processes are often influenced by the orthographic features of the L1. The present study focuses on cross-linguistic comparisons on the relationship between lower-level component skills and reading comprehension of two L1 groups.

## 2. Review of Literature

English-as-a-Second-Language (ESL) learners' skills in word reading efficiency, spelling, and oral reading fluency are closely related to reading comprehension and often affected by their phonological and orthographic processing skills. The following section reviews current research on these skills, their relationship to reading comprehension, and first language influence on these skills.

### *2.1 Word Reading Efficiency*

Word reading efficiency refers to the ability of readers to recognize individual words accurately and rapidly (Adams, 1990). Word reading efficiency can be construed as consisting of two component skills: the ability to sound out words quickly and accurately (phonemic decoding) and the ability to recognize familiar words as whole units (word recognition) (Torgesen, Wagner, & Rashotte, 1999). A large body of literature has been amassed, showing that children have difficulty in reading comprehension when they have difficulties applying phonemic decoding skills in sounding out non-sight (or nonsensical) words (Adams, 1990; Share, 1995; Share & Stanovich, 1995). In addition, poor readers often have "a severely restricted sight vocabulary of words (commonly used words) they can read fluently and automatically" (Torgesen et al., 1999, p. 6).

Lack of efficiency in phonemic decoding and word recognition has been recognized as one of the factors impeding efficient ESL reading comprehension. Previous L2 reading studies showed that variation in word reading efficiency contributes significantly to variation in reading comprehension even among fluent bilinguals (e.g., Favreau & Segalowitz, 1982; Koda, 1996, 1999; Muljani, Koda, & Moates, 1998; Segalowitz, 1986; Segalowitz, Poulsen, & Komoda, 1991). Because reading comprehension is dependent on efficient visual information processing, deficiency in word recognition is directly linked to poor comprehension performance.

Traditionally, a major objective in reading education at the primary school level (K-3) has been to foster phonemic decoding skills and word recognition accuracy. However, accurate word recognition alone is an insufficient indicator of word reading efficiency, especially beyond the early grades. Word recognition can be accurate but slow and effortful. To be efficient in word reading, readers must achieve both accuracy and speed. Lack of efficiency in word recognition places additional demands on reader's cognitive resources, usually at the expense of comprehension (Adams, 1990; Perfetti, 1985, 1999).

### *2.2 Spelling Knowledge*

Like word recognition and phonemic decoding, spelling also relies on grapho-phonemic knowledge of the language (Robbins, Hosp, J. L., Hosp, M. K., & Flynn, 2010). According to Ehri (2000), accurate spelling requires the integration of phonological, orthographic, and morphological knowledge. The lexical quality hypothesis (Perfetti & Hart, 2001) postulates that words are composed of an orthographic constituent, a phonological constituent, and a semantic constituent. When well-learned orthographic forms or spelling representations, also known as a reader's sight vocabulary, become tightly connected to corresponding phonological and semantic forms, word recognition efficiency emerges (Ehri, 2005; Perfetti & Hart, 2001). The importance of spelling knowledge or orthographic representation lies in the understanding that the visual input during reading activates not only the orthographic constituent but also its corresponding phonological and semantic constituents. Therefore, spelling knowledge underpins word recognition efficiency and word recognition efficiency is a function of spelling knowledge (Berninger, Abbott, R., & Abbott, S., 2002; Burt & Tate, 2002; Caravolas, Hulme, & Snowling, 2001; Ehri, 1997; Perfetti, 1992; Perfetti & Hart, 2001; Templeton & Morris, 2000).

A research synthesis by Weiser and Mathes (2011) indicated that instruction in decoding and spelling led to significant gains in phonemic awareness, alphabetic decoding, word reading, fluency, and comprehension; in addition, spelling instruction can foster closer attention to the details of words' orthographic representations in the lower elementary grades. In the field of ESL reading research, English spelling knowledge and English word reading skills are found to be closely related with young ESL learners (Chiappe, Glaeser, & Ferko, 2007; Geva & Zadeh, 2006; Wade-Woolley & Siegel, 1997). However, very little research has been conducted with adult ESL learners on the relationship between spelling knowledge, reading comprehension, and other reading skills (Chiappe et al., 2007; Fender, 2008; Holm & Dodd, 1996; Wade-Woolley & Siegel, 1997).

### *2.3 Oral Text Reading Fluency*

Compared to word reading and spelling, oral text reading may go beyond lower-level processing and involve some higher level text processing skills. However, the main research focus of oral reading fluency has been on rapid and accurate word identification, which has been indicated by measures of speed/rate and accuracy with which text is reproduced into spoken language. This conceptualization of fluency draws its support from the theories of automaticity in reading (LaBerge & Samuels, 1974; Samuels, 1979). Fluency develops as readers move toward automatic decoding and word recognition, enabling them to read words more accurately and rapidly. If readers have difficulty in recognizing familiar words and must pause and struggle to decode unfamiliar words, their ability to understand the meaning of a text is hampered. If they process text too slowly, their memory for the text (i.e., working memory) will be disrupted, which makes it more difficult to make and maintain connections among ideas within a text. As students develop automaticity in word recognition, more cognitive resources will be available for comprehending text (Perfetti, 1977, 1985, 1999; Perfetti & Hogaboam, 1975; Stanovich, 1980).

A recent research interest focuses on how well oral text reading fluency predicts general reading competence and reading comprehension (Dowhower, 1987; Fuchs, L., Fuchs, L., & Maxwell, 1988; Fuchs, L., Fuchs, D., Hosp, & Jenkins, 2001; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003a, 2003b; Shinn, Knutson, Good, Tilly, & Collins, 1992; Tan & Nicholson, 1997). Fuchs and colleagues (Fuchs et al., 2001; Jenkins et al., 2003a, 2003b) showed that oral reading fluency correlated highly with standard reading comprehension measures based on multiple-choice questions. Shinn et al. (1992) found that "oral reading fluency provided a good index of reading proficiency and comprehension" (p. 459). Other researchers reported a strong relationship between oral reading fluency and comprehension (Nathan & Stanovich, 1991; Thurlow & van den Broek, 1997; Wayman, Wallace, Wiley, Ticha, & Espin, 2007; White, 1995). In addition, Saiegh-Haddad (2003) found a strong relationship between EFL oral reading fluency and EFL reading comprehension among Arabic and Hebrew speakers. Geva, Wade-Woolley and Shany (1997) reported that text reading was more efficient than the reading of isolated words in predicting early stage L2 reading acquisition. Jiang, Sawaki and Sabatini (2012) also found that oral text reading fluency correlated more highly with ESL reading comprehension than word reading efficiency and phonemic decoding accuracy among Chinese ESL students. However, the relative importance of these component skills in reading comprehension may vary when we take into consideration learners' first language background and proficiency levels.

### *2.4 L1 Transfer Effects on Orthography-Related Processing Skills*

Research on the contribution of L1 phonological and orthographic processing skills to adult ESL reading is relatively rare. Nassaji and Geva (1999) found that efficiency in phonological and orthographic processing contributed significantly to individual differences on the ESL reading measures among a group of native speakers of Farsi. Gottardo et al. (2001) found that exposure to L1 reading influences processes used by Chinese-speaking children in an English-speaking environment.

Fender (2003) compared the English word recognition and word integration skills among native Arabic and Japanese L1 learners. He found that Japanese ESL learners were faster and more accurate readers of English words though the Arab ESL learners were better at integrating words into larger phrases and comprehend them. Akamatsu (2003) studied L2 text reading abilities among nonalphabetic L1 groups (Chinese and Japanese) and an alphabetic L1 group (Persian). The study found that L2 readers with a nonalphabetic L1 background were less efficient in processing English words than those with alphabetic L1 background.

ESL spelling skills have also been found to be influenced by the L1. Wang and Geva (2003) found that L1 Chinese children acquiring English did as well or better in spelling English words but not pseudo words compared to native English speakers. The results suggest that the native Chinese speakers had acquired English word spellings as whole lexical or visual-orthographic forms but were less able to sound out pseudo words by applying phoneme-level decoding and mapping skills. Holm and Dodd (1996) indicated similar findings on English word recognition and word spelling skills of a group of adult ESL learners from Hong Kong. On the other hand, ESL learners with an L1 Roman alphabetic literacy experience (e.g., German or Spanish) were able to transfer not only letter knowledge but also phonological knowledge and corresponding letter-sound mapping patterns (i.e., grapheme-phoneme correspondences) when they acquire ESL reading and spelling skills (Figueredo, 2006; Muljani, Koda, & Moates, 1998). However, as learners develop their English literacy skills and become more proficient in the language, the strength of L1 effects in spelling gradually fades (Chiappe et al., 2007; Figueredo, 2006).

### *2.5 The Present Study*

The purpose of the study is to investigate the potential impact of L1 background on the lower-level processing skills in ESL reading. Specifically, the study will investigate English word recognition, phonemic decoding, spelling, and oral text reading skills among adult learners with Spanish and Chinese as their first language.

The study aims to address the following questions:

1) How do the Spanish and Chinese L1 groups differ in their performances on English word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency?

2) What are the relationships among measures of word recognition efficiency, phonemic decoding efficiency, spelling, oral text reading fluency, and reading comprehension for each group?

3) How do the measures of word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency predict reading comprehension for each group?

## 3. Method

### *3.1 Participants*

The participants of the study consist of 56 Spanish and 58 Chinese speakers learning English as a second language. They were international students majoring in various academic disciplines in undergraduate and graduate programs at an American university and were advanced ESL learners who scored around 80% on the TOEFL reading comprehension test (see Table 1 in the results section).

### *3.2 Instruments*

#### 3.2.1 Spelling Test

The spelling test includes 36 items, which were selected from a total of 58 words in Fender (2008). According to Fender (2008), these words were familiar and known by intermediate-level ESL students and they represented three types of spelling skills: 1) words for within-word spelling skills which involve short vowels, long vowels, and complex vowels in single-syllable words, 2) words for basic syllable pattern spelling skills with words with consonant doubling, long-vowel with open syllables and short-vowel with closed syllables, and 3) words for multiple-syllable spelling pattern skills with unstressed syllables and derivational spellings. Fender (2008) had 22 words for the first group and 18 for the second and third groups. For this project, 12 words were selected from each of the groups to represent three types of spelling skills, with a total of 36 items. One point was assigned to each correctly-spelled item. The Cronbach alpha reliability estimate was .94 for the spelling test.

#### 3.2.2 Word Recognition and Phonemic Decoding

The present study employs the Test of Word Reading Efficiency (TOWRE) to investigate word recognition and phonemic decoding skills. The TOWRE (Torgesen et al., 1999) comprised two subtests requiring oral reading of real English words (sight word reading) and pronounceable nonwords (phonemic decoding). The Sight Word Reading subtest consisted of 104 real English words, while the Phonemic Decoding subtest consisted of 63 pronounceable nonwords. On both subtests, items were ordered from the easiest to the most difficult. The TOWRE was administered in a one-to-one interview format. Participants' task was to read aloud the lists of real words and pronounceable nonwords as quickly and accurately as possible within 45 seconds. Participants read into a microphone; their voice responses were recorded and saved in digital speech data files.

#### 3.2.3 Oral Text Reading

The oral text reading task was designed to assess learners' fluency in text reading. The reading passage was selected from an ESL reading textbook and is a part of a text on the topic of child adoption. This text consisted of 245 words and was at the Flesch-Kincaid grade level of 8.0.

Each participant was asked to read the text aloud as fast as they could into a microphone. Their voice responses and the time taken to finish reading the text were recorded. After completing oral reading of the passage, participants were asked to summarize what the passage was about in a few sentences. The number of words read correctly per minute (wcpm) was obtained as a measures of oral text reading fluency.

#### 3.2.4 Reading Comprehension

The reading comprehension section of a retired paper-based TOEFL test was used to assess reading comprehension in this study. The TOEFL Reading section is designed to assess English language learners' comprehension of academic reading materials. The test used for this study consisted of five reading passages, each of which is accompanied by multiple-choice comprehension items (50 items in total). The multiple-choice items were scored as right or wrong, with one point for each correct answer. The reliability of the reading test (Cronbach's alpha) was .87 for the present sample.

*3.3 Procedure*

Data collection took place in two sessions. In the first session, the participants took the TOEFL reading comprehension test under a proctored condition for 55 minutes and had 5 minutes to respond to a brief background survey. The second session took place in a computer lab, where the participants took the spelling test, TOWRE Sight Word Reading and Phonemic Decoding tests and the oral text reading test on an individual basis. The spelling test was read by a native speaker of English and the recording was accessed by the participants through a link on a website. The target words were first read, then used in a sentence, and then read again. The recording of the spelling test is approximately 9 minutes long including the directions and two examples.

After the spelling test, the participants completed the TOWRE test. On both the Sight Word Reading and the Phonemic Decoding subtests, each participant was asked to read aloud the lists of real words and pronounceable nonwords as quickly and accurately as possible within 45 seconds. Then the participants were asked to read the text aloud. For the word reading and oral text reading tasks, the participants read into a microphone and their voice responses were recorded and saved in digital speech data files on a computer.

*3.4 Scoring*

The accuracy of the TOWRE sight word reading and phonemic decoding subtests and oral text reading were scored by human raters. Participants' responses to the TOWRE sight word reading and phonemic decoding subtests were scored mainly based on the standard scoring guidelines as provided in the Examiner's Manual (Torgesen et al., 1999). However, we also took into consideration consistent foreign accent and dialectal variations because TOWRE subtests are operationalized as a measure of decoding/word recognition rather than a measure of speaking or pronunciation. Students should not be penalized simply because they have an accent. For example, some participants consistently pronounced the vowel /ai/ in *find* and *kind* as something like /εi/. In addition, some students followed the British pronunciation for the word *fast* [fa:st] instead of the American pronunciation. These variations were scored as correct. The same standard also applied in the scoring of accuracy for oral text reading.

Three raters were involved in the scoring procedure; one served as the primary rater and the other two as secondary raters. As part of the rater training, the raters first scored seven identical practice responses individually, and then met to compare scores and discuss scoring issues. Having reached good agreements about rating decisions, they started to grade all the responses following a predetermined rating design. Participants' responses to the three tasks (sight word reading, phonemic decoding, and oral text reading) were randomly assigned to the raters. The order of assignment was randomized for each response batch for each rater. Approximately 25% of the responses were double scored to check inter-rater reliability. For each of the three tasks, the percentage of items agreed upon by a given rater pair with respect to accuracy scoring was calculated for each participant. Then, the percentages were averaged across all double-scored responses for each task separately. The average rater agreement rates were 97%, 90% and 99% for the accuracy of sight word reading, phonemic decoding, and oral text reading, respectively. Since the inter-rater reliability was acceptable for all the tasks, scores of the primary rater were used for the double scored samples.

For the TOWRE subtests, the number of words read correctly per minute (wcpm) were used (instead of words read correctly per 45 seconds) to represent the constructs of word recognition efficiency and phonemic decoding efficiency. Participants' performance on the oral text reading task was also adjusted as the number of words read correctly per minute (wcpm), which represents the construct of oral text reading fluency.

## 4. Results

### *4.1 Differences in the Lower-Level Processing Skills*

Table 1 presents the means and standard deviations of the measures. As shown in the table, the Spanish and Chinese learners of English had little difference in their reading comprehension ability. Both groups scored around 80% in the TOEFL reading comprehension test and they are advanced-level English learners.

**Table 1. Descriptive Statistics**

| | Chinese (N = 56) | | Spanish (N = 58) | |
|---|---|---|---|---|
| | M | SD | M | SD |
| Spelling | 29.92 | 4.54 | 33.64 | 2.91 |
| Word Recognition Efficiency | 88.72 | 13.85 | 89.98 | 16.24 |
| Phonemic Decoding Efficiency | 56.65 | 8.28 | 65.13 | 12.47 |
| Oral Text Reading Fluency | 133.92 | 18.24 | 153.04 | 18.29 |
| Reading Comprehension | 39.27 | 6.08 | 38.76 | 7.98 |

To answer the first research question—how the two groups differ in their performances on word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency, multivariate analysis of variance (MANOVA) was conducted with L1 as an independent variable, measures of word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency as dependent variables. The multivariate test showed statistical significance for L1 ($F = 13.22$, $p < .001$). Results from multiple comparisons showed no significant difference between the two groups in reading comprehension. However, significant differences were noted for spelling ($F = 16.19$, $p < .001$), word recognition efficiency ($F = 5.25$, $p < .05$), phonemic decoding efficiency ($F = 33.99$, $p < .001$), and oral text reading fluency ($F = 16.59$, $p < .001$), with the Spanish speakers performing consistently better than the Chinese speakers in all of the significant comparisons.

To answer the second research question on the relationships among measures of word recognition efficiency, phonemic decoding efficiency, spelling, oral text reading fluency, and reading comprehension for each L1 group, correlation analyses were conducted. Table 2 displays the correlations among the variables for each group.

**Table 2. Intercorrelations among Scores on the Processing Skills and Reading Comprehension**

| | | Reading Comprehension | Spelling | Word Recognition Efficiency | Phonemic Decoding Efficiency |
|---|---|---|---|---|---|
| Chinese | Spelling | .56** | | | |
| | Word Recognition Efficiency | .36* | .41* | | |
| | Phonemic Decoding Efficiency | .56** | .48** | .53** | |
| | Oral Text Reading Fluency | .45** | .59** | .55** | .66** |
| Spanish | Spelling | .46** | | | |
| | Word Recognition Efficiency | -.10 | .01 | | |
| | Phonemic Decoding Efficiency | .32 | .33 | .35* | |
| | Oral Text Reading Fluency | .71** | .51** | .35* | .60** |

* p < .05 (2 tailed), ** p < .01 (2-tailed).

The results showed that for the Chinese group, phonemic decoding efficiency and spelling have the same highest correlation with reading comprehension ($r = 0.56$, $p < 0.01$); they also correlated most highly with oral text reading fluency ($r = 0.66$ for phonemic decoding efficiency, and $r = 0.59$ for spelling, $p < 0.01$). For the Spanish group, the most notable correlation was between oral text reading fluency and reading comprehension ($r = 0.71$, $p < 0.01$), followed by the correlation between oral text reading fluency and phonemic decoding efficiency ($r = 0.60$, $p < 0.01$).

To answer the third research question, stepwise regression analyses were conducted for each group to see how their reading comprehension has been influenced by these lower-level processing skills. The independent variables were spelling knowledge, word recognition efficiency, phonemic decoding efficiency, and oral text reading fluency. The dependent variable was their reading comprehension scores. The results of the regression analyses are shown in Table 3.

**Table 3. Stepwise Regression Analyses for Each Group on Reading Comprehension**

| | Model | $R^2$ | Adjusted $R^2$ | Beta | t | Sig. |
|---|---|---|---|---|---|---|
| Chinese | 1 Phonemic Decoding Efficiency | .313 | .294 | .560 | 3.998 | < .001 |
| | 2 Phonemic Decoding Efficiency | .421 | .386 | .380 | 2.547 | < .05 |
| | Spelling | | | .374 | 2.506 | < .05 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Spanish | 1 Oral text reading Fluency | .502 | .486 | .709 | 5.595 | < .001 |
| | 2 Oral text reading Fluency | .642 | .618 | .849 | 7.276 | < .001 |
| | Word Recognition Efficiency | | | -.399 | -3.418 | < .01 |

The multiple regression models demonstrated that these lower-level processing skills played different roles in L2 reading comprehension of the two L1 groups. For the Chinese L1 group, phonemic decoding efficiency alone accounted for 29.4% of the variance in reading comprehension. Spelling also contributed significantly to reading comprehension. Together they accounted for about 38.6% of the variance. For the Spanish L1 group, oral text reading fluency alone accounted for 48.6% of the variance in reading comprehension. Word recognition efficiency also contributed significantly to reading comprehension. Together the two variables accounted for 61.8% of the variance in English reading comprehension.

## 5. Discussion

The analyses in the results section provided answers to the research questions this study aimed to address. The following discussion will first answer these questions before addressing the potential impact of L1 orthography on the lower-level processing skills in L2 English reading development.

Research Question #1: How do the Spanish and Chinese L1 groups differ in their performances on English word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency?

Even though there was no significant difference between the two groups on their ESL reading comprehension abilities, the Spanish group performed significantly better than the Chinese group on all the four lower-level processing skills, namely, spelling, word recognition efficiency, phonemic decoding efficiency, and oral text reading fluency. We don't know exactly how the Chinese L1 group managed to achieve the same level of ESL reading comprehension as the Spanish L1 group, but there are a few possible explanations. First, there might be a threshold level in these lower-level processing skills which the Chinese ESL learners were able to achieve. In other words, automaticity in lower-level processing may indicate a range of performance. Even though the Chinese L1 group did not performance as well as the Spanish L1 group, their ability might have been within the range of automaticity (to ensure comprehension) or passed the threshold level; therefore, the relative weakness compared to the Spanish group does not exert important influence in the comprehension outcomes. Second, according to the theoretical concepts of efficiency and compensation, it is possible that the Chinese L1 group compensated for their relative inefficiency in these lower-level processing skills with other skills such as higher-level processing skills. Third, due to the differences in first language orthographic backgrounds, the route of word identification might also be different for these two groups of ESL learners. Reading research has consistently demonstrated that there are three underlying constituent processes in word identification across writing systems, orthography, phonology, and semantics. Many researchers agree that in reading for meaning, both the direct route from orthography to semantics and the route from orthography to semantics via phonology are possible in identifying a word.

Research question #2: What are the relationships among measures of word recognition efficiency, phonemic decoding efficiency, spelling, oral text reading fluency, and reading comprehension for each group?

First, for the Chinese group, phonemic decoding efficiency and spelling had the same highest correlation with reading comprehension ($r = 0.56$, $p < 0.01$), and they also had highest correlations with oral text reading fluency ($r = 0.66$ for phonemic decoding efficiency, and $r = 0.59$ for spelling); while for the Spanish group, the highest correlation was between oral text reading fluency and reading comprehension ($r = 0.71$, $p < 0.01$). Second, the relationship between spelling and the two word reading efficiency measures (word recognition efficiency and phonemic decoding efficiency) is also worth noting. For the Spanish group, spelling does not correlate significantly with word recognition efficiency or phonemic decoding efficiency, but it correlates moderately with word recognition efficiency and phonemic decoding efficiency for the Chinese group.

For the Spanish ESL learners, oral text reading fluency has a stronger relationship with reading comprehension than measures of word recognition efficiency, phonemic decoding efficiency, and spelling, which is actually consistent with findings in English L1 research (Nathan & Stanovich, 1991; Thurlow & van den Broek, 1997; Sabatini, 2002; Torgesen et al., 2001). Prior research reported different levels of correlation between oral text reading fluency and the overall reading competence. Jenkins and colleagues (2003a, 2003b) reported that correlation with reading comprehension among a group of 4th grade students was .83 for oral text reading fluency and .53 for wordlist efficiency. Sabatini, Sawaki, Shore and Scarborough (2010) found that correlation with reading comprehension among adults with low literacy was .49 for word reading efficiency, .26 for phonemic decoding efficiency, and .54 for oral text reading fluency. Fuchs and colleagues (1988) found that correlation between oral text reading fluency and reading comprehension was as high as .91 among students with reading disability. In EFL research, Nassaji and Geva (1999) reported that correlation with reading comprehension among a group of native Farsi speakers was .53 for word recognition efficiency, .30 for phonemic decoding efficiency, and .71 for silent text reading rate. Saiegh-Haddad (2003) and Jiang et al. (2012) also found a stronger relationship between EFL/ESL oral text reading fluency and English reading comprehension compared to the relationships between varying word level processing skills and reading comprehension.

In contrast with the Spanish group for whom oral text reading fluency has a stronger relationship with reading comprehension, the findings of this study also showed that the processing skills that have the highest correlation with reading comprehension were phonemic decoding efficiency and spelling for the Chinese L1 group. In other words, oral text reading fluency does not always have a stronger relationship with reading comprehension than other lower-level processing skills do. In fact, the current study indicates that the processing skills that have the highest correlation with reading comprehension vary across different L1 groups.

Research question #3: How do the measures of word recognition efficiency, phonemic decoding efficiency, spelling, and oral text reading fluency predict reading comprehension for each group?

The multiple regression models demonstrated that these lower-level component skills played different roles in L2 reading comprehension of the two L1 groups. For the Chinese L1 group, phonemic decoding efficiency and spelling together accounted for about 38.6% of the variance. For the Spanish L1 group, oral text reading fluency and word recognition efficiency together accounted for 61.8% of the variance in reading comprehension.

*5.1 The Potential Influence of L1 Orthographical Features*

The differences in the performances of ESL learners on these lower-level processing skills and the different roles these skills play in ESL reading comprehension may have to do the varying orthographic distance between learners' L1 and L2. Orthographies vary in two dimensions: representational units and orthographic depth. Based on the differences in the representation of graphemic symbols, a graphemic symbol represents a phoneme in an alphabet system, a syllable in a syllabary system, and a morpheme in a logographic system. Like English, Spanish is an alphabetic language while Chinese characters represent a logographic writing system.

In addition to the variations in representational units, orthographic systems also vary in depth. Orthographic depth refers to the degree of regularity in sound-symbol correspondence. In shallow (i.e., phonologically regular) orthographies such as Spanish, a phonological code is prelexically assembled through intraword analysis, whereas in deep (i.e., phonologically opaque) orthographies, phonological processing depends, in varying degrees, on lexical information. English orthography, for example, is phonologically less regular than Spanish because of its morphophonemic representation. A lack of phonological transparency generally prohibits systematic one-to-one symbol-to-sound mappings.

In a logographic system such as Chinese characters, individual symbols are associated with the meaning and the sound of an entire word or morpheme. Phonological information is accessed lexically through whole-word activation in visual word recognition due to the holistic morpheme-based linkages between sounds and logographic symbols (Gleitman, 1985; Perfetti & Zhang, 1995; Zhou & Marslen-Wilson, 1994). Although most Chinese characters can be further componentized into radicals which can provide information on the meaning or pronunciation of the character, the correspondence between a radical (semantic or phonetic) and a character is not reliable and often varies from character to character (Wang & Yang, 2008). In general, the character-to-phoneme mapping occurs at a low level of systematicity (Perfetti & Dunlap, 2008). Therefore, the Chinese orthography is considered yet deeper than English due to its unreliable character-to-sound relationship.

The Orthographic Depth Hypothesis contends that orthographic depth is directly related to the amount of lexical involvement in obtaining a word's phonology or pronunciation. Based on the Orthographic Depth Hypothesis, an L1 learner in the shallow language relies easily on letter-to-sound correspondence as the major developmental path to L1 word recognition. Students of an alphabetic language with a shallow structure may rely on predictable orthography-to-phonology correspondence in L1 word learning. In a deeper alphabetic orthography, an L1 learner must learn the opaque and complex letter-to-sound relationship through analogies with the known sight words. In the logographic orthography such as Chinese, an L1 learner must learn the character-to-phoneme relation in each character individually, occasionally using phonetic radicals to aid the learning of its pronunciation. Thus, as the orthographies of languages become deeper, L1 learners increasingly rely on higher and higher cues in word recognition.

Because orthographies vary from language to language, the development of L2 reading skills could be influenced by the orthographic features of learners' L1. Cross-linguistic research has demonstrated superior word recognition performance among learners with related L1 orthographic backgrounds compared to learners with unrelated L1 orthographic backgrounds (Koda, 1988, 1989; Muljani, Koda, & Moates, 1998). There is evidence that Chinese learners of English are different from students of an alphabetic L1 background in phonetic awareness and decoding processes (Koda, 1998). The current study showed that the Spanish ESL learners performed significantly better than their Chinese counterparts in spelling, word recognition efficiency, phonemic decoding efficiency, and oral text reading fluency, which corresponds with the two directions of the orthographic depth continuum. The performance pattern observed in this study seems to support the Orthographic Depth Hypothesis. More cross-linguistic research is needed to further explore the possible influence of L1 orthographic features on ESL reading development.

Due to the differences in L1 backgrounds, learners may have to resort to different strategies to achieve the same level of reading comprehension. The different strategies in spelling, word recognition, phonemic decoding, and oral text reading may have important implications for the development of reading fluency and reading comprehension among ESL readers of various first language backgrounds.

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