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Profiling Adult L2 Readers in English Bridge Programs: A Not-So-Simple View of L1 Effect

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Abstract
This study aimed to validate the Simple View of Reading (SVR) in L2 English readers with alphabetic and morphosyllabic L1 writing system backgrounds. Forty-five L2 English learners enrolled in American university bridge programs completed a set of tasks that measured real word decoding efficiency, pseudoword decoding efficiency, linguistic (listening) comprehension, passage reading comprehension, and word meaning inferencing. There were two major findings: (1) only pseudoword decoding efficiency predicted passage reading comprehension in learners with a morphosyllabic L1, whereas both pseudoword decoding efficiency and linguistic comprehension were significant predictors in learners with an alphabetic L1; (2) pseudoword decoding efficiency was a significant predictor of word meaning inferencing in learners with a morphosyllabic L1, and moderated the effect of real word decoding efficiency on word meaning inference in learners with an alphabetic L1. The findings indicate the complex relationships among word decoding, linguistic comprehension, and passage reading comprehension in adult L2 English learners.

Keywords Simple View of Reading · First language writing system · Decoding threshold hypothesis · Linguistic threshold hypothesis · Adult second language acquisition

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Introduction

The Simple View of Reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990), an influential model of reading comprehension that has received much attention in first language (L1) reading research, conceptualizes reading comprehension as the product of two component skills, decoding and linguistic comprehension. In recent years, there has been increased interest in adopting the SVR in the second language (L2) and bilingual reading research as well (see a meta-analysis of child bilingual reading in Melby-Lervåg & Lervåg, 2011 and a review of foreign language reading in Sparks, 2021). While some research has suggested that the SVR is equally valid for L1 and L2 reading (e.g., Verhoeven & van Leeuwe, 2012), recent research has found that additional complexities need to be accounted for when applying the SVR to L2 reading (e.g., Verhoeven et al., 2019; Zhang & Ke, 2020). Specifically, there is still a debate over the additive versus multiplicative relationship between decoding and linguistic comprehension in predicting L2 reading comprehension (e.g., Erbeli & Joshi, 2022; Farnia & Geva, 2013). Furthermore, the majority of prior studies of the SVR in L2 reading have focused on bilingual child or adult learners of two alphabetic languages (e.g., Spanish and English), and there have been only a few studies involving non-alphabetic L1 learners of L2 English (e.g., Zhang & Ke, 2020). The present study examined the predictive ability of the SVR among adult L2 English learners enrolled in American university bridge programs, and explored the effects of different L1 writing system backgrounds (i.e., morphosyllabary versus alphabet) on the relative contributions of L2 decoding and L2 linguistic comprehension to L2 reading comprehension. It is expected that the findings will help expand current understandings of the complex interrelationships among L2 reading comprehension component skills, and provide pertinent implications for reading assessment and instruction in English bridge programs with learners of different L1 writing system profiles and needs.

The Simple View of Reading and the Decoding and Linguistic Thresholds in English Reading

The Simple View of Reading (SVR) proposes that reading comprehension is the multiplicative product of decoding and linguistic comprehension (Gough & Tunmer, 1986). Both components are necessary, but either alone is insufficient for reading comprehension (Hoover & Gough, 1990). In this view, decoding is defined as retrieving appropriate phonological and semantic information from printed input, and is often operationalized as the ability to read aloud isolated real words and pseudowords (Hoover & Gough, 1990). Linguistic comprehension is defined as the linguistic process involved in oral language comprehension of words, sentences, and discourse, and is often operationalized as listening comprehension (Verhoeven & Leeuwe, 2012). Reading comprehension is typically defined as learners' ability to retrieve meaning from printed texts, and assessed via passage reading comprehension and/or word meaning inferencing via text reading (e.g., Hamada & Koda, 2010). To date, there has been substantial evidence validating the SVR in alphabetic and nonalphabetic monolingual child reading as well as in alphabetic child bilingual reading (Melby-Lervåg & Lervåg, 2011; Trapman et al., 2017), yet to the best of our knowledge, there are few studies that examine the joint contributions of decoding and linguistic knowledge to adult L2 readers with morphosyllabic L1 backgrounds within the SVR framework. The explanatory power of the SVR in L1 and L2 reading research pertains to two hypotheses in the existing literature, i.e., the Decoding Threshold Hypothesis (Wang et al., 2019) and the Linguistic Threshold Hypothesis (Clarke, 1980; Cziko, 1980). The Decoding Threshold Hypothesis suggests that a minimum amount of decoding ability needs to be reached before higher-level reading processes can operate for successful reading comprehension. Wang et al. (2019) tested the Decoding Threshold Hypothesis in a longitudinal study of over 30,000 U.S. Grades 5 to 10 students' reading comprehension growth as a function of their initial decoding ability. Based on nonlinear statistical analyses, Wang et al. (2019) identified about 38% of Grade 5 students and 19% of Grade 10 students below the decoding threshold (measured by the Reading Inventory and Scholastic Evaluation/RISE battery of reading tests, Sabatini et al., 2015). These below-threshold students did not make progress in their reading comprehension scores in the following three years. Considering that English decoding instruction is no longer provided for upper-grade level students in the U.S., Wang et al. (2019) proposed that effective decoding intervention should be targeted to those below the threshold level, and cautioned that the benefit of decoding intervention probably takes time to manifest in reading comprehension.

There might be doubt about how phonological decoding can contribute to meaning retrieval during text-level reading comprehension. A possible explanation is that the increased automatization of phonological decoding frees up resources for higher-level processing and facilitates the integration of lower-level (sublexical and lexical) information for higher-level text meaning construction in working memory (Hamada & Koda, 2010; Prior et al., 2014; Schmidtke & Moro, 2020). For example, Schmidtke and Moro (2020) conducted an eight-month eye movement study tracking word and passage reading behaviors in students enrolled in a Canadian university English bridge program, and observed a shift from a sublexical to a holistic word-processing strategy. They interpreted the result as evidence of a transition from phonological decoding to word reading that engages higher-order meaning integration.

Another possible explanation for the link between phonological decoding and reading comprehension is pertinent to the Self-Teaching Hypothesis (Share, 1995), which indicates that efficient word decoding allows students to connect unfamiliar printed words with phonological representations as they recognize and then learn novel words. However, successful L2 new word learning or word meaning inferencing through reading also depends heavily on an L2 learner's linguistic knowledge. As proposed in the Linguistic Threshold Hypothesis (Clarke, 1980; Cziko, 1980), in order to read in a second language, a level of L2 linguistic comprehension must first be achieved. The Linguistic Threshold Hypothesis is supported by both empirical (e.g., Sparks & Luebbers, 2018) and meta-analytic findings (e.g., Jeon & Yamashita, 2014). For example, Sparks and Luebbers (2018) compared the performance of U.S. high school students completing first-, second-, and third-year Spanish courses with monolingual Spanish readers from first to eleventh grades in a set of standardized measures of Spanish word decoding and reading comprehension. They classified these students into four reader types according to SVR (i.e., good readers, as well as dyslexic, hyperlexic, and garden variety poor readers). Poor reading skills were indexed by cutoff scores below the 15th percentile (i.e., 1.0 standard deviation/SD below the mean). It was found that the majority of students fit the hyperlexic profile (with better word decoding than reading comprehension skills). According to Sparks and Luebbers (2018), their findings indicated that L2 learners in the U.S. high school need to improve not only their L2 reading comprehension but also their L2 oral language skills[1].

Interrelationships Between Decoding and Linguistic Comprehension in L2 Reading Comprehension

It is generally agreed that decoding and linguistic comprehension each uniquely contribute to L2 reading comprehension (Huo et al., 2021; Sparks, 2021; Verhoeven & Leeuwe, 2012). Yet, there are mixed findings in response to two questions: (1) *what are the relative contributions of decoding and linguistic comprehension?*, and (2), *how do decoding and linguistic comprehension jointly contribute to L2 reading comprehension?*

Regarding the first question, some L2 reading research identified linguistic comprehension as a stronger predictor of reading comprehension than decoding (e.g., Babayiğit, 2015; Bonifacci & Tobia, 2017; Cho et al., 2019; Jeon & Yamashita, 2014; Sparks, 2021; Verhoeven & Leeuwe, 2012), while other research suggested that decoding played a more important role (e.g., Erbeli & Joshi, 2022; Kang, 2020; Mancilla-Martinez et al., 2011; Nakamoto et al., 2008). For example, in their meta-analysis of 18 studies involving 2363 L2 learners, Jeon and Yamashita (2014) found L2 reading comprehension was more strongly correlated with listening comprehension ($r = 0.77$) than with decoding ($r = 0.56$). Similarly, Bonifacci and Tobia (2017) examined the applicability of the SVR model among 260 bilingual language-minority children who spoke Italian as a second language. These children either attended the first 2 years or the last three years of primary school. They found that, for both groups, listening comprehension was the more powerful predictor of reading comprehension than reading accuracy and speed. In contrast, Erbeli and Joshi (2022) examined the joint contributions of word decoding and linguistic comprehension (operationalized as listening comprehension and vocabulary size) to reading comprehension with a series of standardized assessments in 690 L1 Slovenian seventh graders learning English as a foreign language (EFL). They found that word decoding was a much stronger predictor ($r = 0.87$) than linguistic comprehension ($r = 0.16$).

Studies on bilingual children indicate that there might be no single answer to this question, and the relative contributions of decoding and linguistic comprehension may vary by age and the orthographic features of the L2 writing system. Aggregate evidence has suggested that the relative contributions of decoding and linguistic comprehension to reading change over the years as children become more proficient readers, with the impact of decoding on reading diminishing and linguistic comprehension becoming increasingly important (e.g., Adlof et al., 2006; Droop & Verhoeven, 2003; Lervåg & Aukrust, 2010a, 2010b; Verhoeven & Leeuwe, 2012). Furthermore, the orthographic features of the target L2 writing system seem to alter the relative contributions of these two components (Florit & Cain, 2011; Joshi, 2018). In a meta-analysis which included beginning readers of English and other more transparent orthographies with consistent sound-letter correspondence (e.g., Dutch, Spanish), Florit and Cain (2011) reported that the relative influences of decoding and linguistic comprehension on reading comprehension were altered by the transparency of the L2 orthography: for readers of transparent orthographies, linguistic

[1] It should be noted that Sparks and colleagues also proposed the Linguistic Coding Differences Hypothesis (LCDH, Sparks, 1995; Sparks & Ganschow, 1993). Sparks (2021) pointed out the LCDH was not developed to explain foreign language reading development, but helped identify at-risk learners.

comprehension had greater influence on reading comprehension than did decoding; for L2 English readers, decoding played a more important role than linguistic comprehension. Collectively, these results suggest that the findings regarding the relative contributions of decoding and linguistic comprehension to reading among bilingual (child) readers are mixed and there may be factors such as age and orthography that may moderate these contributions. It should be noted that the present study focuses on adult L2 readers, and orthography might be more relevant in this regard.

In addition, sparse but mixed results have been observed in terms of the way in which decoding and linguistic comprehension jointly contribute to reading comprehension. The original formulation of the Simple View of Reading proposed that the contributions of decoding and linguistic comprehension to reading comprehension was multiplicative in nature (i.e., Reading = Decoding x Linguistic Comprehension), and this has been supported by some research evidence (e.g., Ghaedsharafi & Yamini, 2011; Pasquarella et al., 2012). On the other hand, some researchers (e.g., Erbeli & Joshi, 2022; Sparks & Patton, 2016) have found that an additive model better explained the L2 learners' performance (Reading = Decoding + Linguistic Comprehension). To be specific, Ghaedsharafi and Yamini (2011) demonstrated a multiplicative relationship between linguistic comprehension and decoding. In the study, the researchers measured EFL reading comprehension (RC; measured using a researcher-designed cloze test), word decoding (WD; measured with a researcher-designed word and nonword reading task), and linguistic comprehension (LC; measured with a TOEFL listening test) in L1 Persian female adolescent and adult EFL learners (aged 15–25 years old). The results suggested that a combined model (i.e., WD + LC + WD × LC = RC) fit best; in other words, there was a significant interaction effect between word decoding and linguistic comprehension in predicting EFL reading comprehension in this L1 Persian EFL learner group. In contrast, Erbeli and Joshi (2022) reported the opposite pattern. They found that word decoding and linguistic comprehension were independent and significant predictors of EFL reading comprehension. Unlike Ghaedsharafi and Yamini (2011), there was no interaction effect between the two predictors among 690 L1 Slovenian seventh grade learners of English as a foreign language (EFL). Similarly, Sparks and Patton (2016) operationalized word decoding as pseudoword and real word decoding and linguistic comprehension as listening comprehension among 165 English-speaking learners of Spanish who were high school students in the United States. They found that there was no interaction effect between Spanish word decoding and language comprehension in predicting Spanish reading comprehension skills. These two components affected Spanish reading comprehension independently and roughly to the same extent (decoding: 35.0%; language comprehension: 31.3%).

The inconclusive results about the interrelationships between word decoding and linguistic comprehension in L2 reading comprehension reviewed above could be due to the different research sites and educational contexts (e.g., target language as a second or societal language versus target language as a foreign or nonsocietal language) as well as measurement effects. Some studies used standardized assessment tools while others mixed standardized and researcher-designed tasks. Another possible determining factor, yet underexamined in existing literature, is the impact of learners' L1 writing system background (Jiang, 2016; Koda, 2005).

L1 Writing System Impact on L2 English Reading Comprehension

According to Koda (2005), L1-L2 distance is an important factor in adult L2 reading development given their extensive L1 reading experience and the fact that L2 reading involves dual language processing. Regarding the impact of adult L2 English learners' L1 writing system background, previous research mainly has adopted a between-subject design and compared the reading performance between L2 English learners with an alphabetic L1 and those with a non-alphabetic L1 (e.g., Brown & Haynes, 1985; Hamada & Koda, 2010; Jiang, 2016; Zhang & Ke, 2020). The assumptions are that, first, similarity between L1 and L2 writing systems (e.g., an alphabetic L1 and an alphabetic L2) facilitates L2 learners' reading component skill development; secondly, the contributions of component skills to L2 reading acquisition vary between L2 learners of different L1 backgrounds (see also Koda, 2005). It should be noted that, following Hamada and Koda (2010), we operationalize reading comprehension as passage reading comprehension and word meaning inferencing, and thus review studies that measure passage reading comprehension (e.g., Brown & Haynes, 1985; Xue, 2021) or word meaning inferencing (e.g., Hamada & Koda, 2010) in what follows.

To our knowledge, Brown and Haynes (1985) was among the first studies to compare the component skills of L2 English reading comprehension in learners with an alphabetic L1 background (i.e., Arabic and Spanish) and those with a non-alphabetic L1 background (i.e., Japanese). They found that L2 English linguistic comprehension (operationalized as vocabulary knowledge, grammar knowledge, and listening comprehension) correlated significantly with reading comprehension in L1 Arabic and Spanish-speaking learners of English, but did not find such a correlation in L1 Japanese learners. In terms of word decoding (operationalized as visual discrimination, and translation from spelling to sound), L1 Japanese learners were faster and more accurate than L1 Arabic and Spanish learners in reading aloud familiar short word stimuli, but not as efficient in reading aloud long word stimuli. Brown and Haynes (1985) posited that the emphasis on written English learning in the L1 Japanese learners' previous education experiences might prompt them to be better at decoding than linguistic comprehension, which led to the minimal correlation between linguistic comprehension and reading comprehension in L1 Japanese learners of L2 English. The findings of Brown and Haynes (1985) in Japanese L2 English learners seemed to contrast with those observed in Jiang (2016) and Xue (2021). Jiang (2016) found that decoding (operationalized as oral reading fluency and accuracy) did not predict English reading comprehension among Chinese and Japanese learners of English as a second language (ESL), while it did contribute significantly to the reading comprehension of the Arabic and Spanish ESL groups. More recently, Xue (2021) tracked L2 English reading development in university English majors for nine months in mainland China. Xue reported that while linguistic comprehension (measured with an English grammar test) was not a significant predictor of reading comprehension at the pre-test, it played a significant role in predicting reading comprehension after nine months. Xue (2021) held that learning to read in L2 development was a dynamic and multidimensional process, and that higher-level linguistic comprehension was crucial to reading comprehension as the lower-level cognitive skills became automated. However, Xue did not examine the relative contributions of decoding and linguistic comprehension to reading comprehension.

As mentioned earlier, the studies of Brown and Haynes (1985), Jiang (2016), and Xue (2021) measured reading comprehension with passage-level reading tasks, whereas Hamada and Koda (2010) focused on both passage-level reading comprehension and word meaning inferencing. Hamada and Koda (2010) compared how real word and pseudoword decoding efficiency correlated with English reading comprehension and word meaning inferencing between learners with an alphabetic (Korean) and morphosyllabic (Chinese) L1 who were learners of L2 English in American universities. Their findings suggested that an alphabetic L1 background was associated with better L2 decoding, and decoding was significantly correlated with reading comprehension and word meaning inferencing for the alphabetic L1 group, but not for the morphosyllabic L1 group. However, no linguistic comprehension task was included in the study by Hamada and Koda (2010).

Taken together, the Simple View of Reading, which conceptualizes reading comprehension as a product of decoding and linguistic comprehension, has received plenty of empirical support in L1 reading research and an adequate amount of evidence in child bilingual reading research, yet the evidence in adult L2 reading research is just emerging. Existing research findings regarding the relative contributions of, and interrelationships between, decoding and linguistic comprehension in adolescent or adult L2 English reading comprehension are mixed and inconsistent, possibly due to the variance in research such as educational contexts, and L2 learner prior literacy experiences, as well as the measurement design. There are three major gaps that remain: (1) The existing literature on adolescent and adult L2 reading has generated extensive discussion of the Linguistic Threshold (Clarke, 1980; Cziko, 1980), yet there is little research into a possible Decoding Threshold (Wang et al., 2019). (2) Prior studies that aimed to validate the SVR in adolescent or adult L2 reading have focused on learners who share the same L1 background and learn English as a foreign/non-societal language (e.g., Erbeli & Joshi, 2020; Ghaedsharafi & Yamini, 2011; Kang, 2020; Xue, 2021); to our knowledge, much less attention has been paid to potential differences between adult L2 English learners with different L1 writing system backgrounds. (3) Regarding measurement design, it is common for researchers to assess word decoding with real and pseudoword reading tasks and linguistic comprehension with listening comprehension, yet researchers varied in how they defined and measured reading comprehension: some studies focused on passage reading comprehension only (e.g., Brown & Haynes, 1985); others also included word meaning inferencing (e.g., Hamada & Koda, 2010). Thus, there is a need for probing the interrelationships among decoding, linguistic comprehension, and different reading comprehension outcomes.

In view of the gaps mentioned earlier, this exploratory study sets out to explore the validity of the SVR for adult L2 English learners from two different L1 writing system backgrounds (i.e., morphosyllabary and alphabet). We operationalized reading comprehension as passage reading comprehension and word meaning inference, linguistic comprehension as listening comprehension, and word decoding as real word efficiency and pseudoword decoding efficiency (see detailed measurement descriptions in the "Method" section). Three research questions guided the study:

1. Do L1 morphosyllabary and L1 alphabet readers of L2 English with matched reading comprehension proficiency (passage reading comprehension and word meaning inferencing) differ in their L2 real word decoding efficiency, pseudoword decoding efficiency, or listening comprehension?
2. To what extent do L2 real word decoding efficiency, pseudoword decoding efficiency, and listening comprehension contribute to L2 English passage reading comprehension and word meaning inferencing in L1 morphosyllabary learners?
3. To what extent do L2 real word decoding efficiency, pseudoword decoding efficiency, and listening comprehension contribute to L2 English passage reading comprehension and word meaning inferencing in L1 alphabet learners?

Method

Participants

Forty-five L2 English learners with no reported learning disabilities were recruited from intensive English bridge program intermediate and advanced-level courses at two universities in the Midwest of the United States between Fall 2019 and Spring 2020. Among the 45 participants, 25 were of L1 Chinese (morphosyllabary) background; the other 20 had alphabetic L1s (including Arabic[2], French, Korean, and Turkish). There were 23 females and 22 males. Their age ranged from 19 to 29 years old (M = 22.22, SD = 2.81). Regarding the highest education level, thirteen out of the 45 participants had no more than a high school degree, 30 participants reported postsecondary-level education experiences for an average of 2.0 years in their home countries, and two participants did not report relevant information.

In the English bridge programs, students received about 20 h of intensive English instruction per week in listening, speaking, reading, writing, and grammar. In order to graduate from the English bridge programs and become eligible to apply for full-time university academic admission, the students needed to obtain a minimum TOEFL score of 71 on the Internet-based version or a minimum IELTS score of 6.0. It typically takes four to twelve months for intermediate and advanced students to graduate from the English bridge programs. By the time of data collection, the participants had not met the English proficiency requirement yet. They had spent about an average of four months in the program (ranging from three to eight months).

Instruments

Five paper-and-pencil tasks were administered in addition to a background questionnaire.

Passage Reading Comprehension

This was measured using a retired TOEFL test that asked participants to read a passage about nineteenth-century politics in the U.S. and answer fourteen multiple-choice questions that tapped into L2 learners' gist comprehension, local information searching, co-referencing, and text-based inferencing. The maximum score possible was 14 points. Cronbach's alpha was 0.55.

Word Meaning Inferencing

This test was adopted from Lin (2003), whose study aimed to determine the strategies for guessing unfamiliar word meanings during English reading among Taiwanese high school and college freshmen. The participants in the present study were required to read an expository passage about healthy living that contained 271 words (Flesch Kincaid Reading Ease index and grade level were 74.1 and 6, respectively) and guess the meanings of nine real words underlined in the passage (see a list of word items in "Appendix A"). They were

[2] Arabic has been classified as an abjad or alphabetic language in previous research. We treat it as an alphabetic language in this study.

asked to write down the meaning in English. Each answer with both the correct meaning and correct part-of-speech was awarded two points; if the meaning was correct but the part-of-speech was wrong, one point was awarded. The maximum score possible was 18 points. Cronbach's alpha was 0.60.

Real Word Decoding Efficiency

This test was adopted from Form A of the *Test of Word Reading Efficiency–Second Edition* (TOWRE–2) (Torgesen et al., 1999). Participants were asked to read aloud a list of 108 English real words as fast and as accurately as possible within 45 s. Raw scores were transformed into scaled/standard scores based on the age range between 17 years 0 months and 24 years 11 months in the TOWRE-2 manual. Cronbach's alpha was 0.60.

Pseudoword Decoding Efficiency

This test was also adopted from Form A of the *Test of Word Reading Efficiency–Second Edition* (TOWRE–2) (Torgesen et al., 1999). Participants were asked to read aloud a list of 66 English pseudowords as fast and as accurately as possible within 45 s. Also, raw scores were translated into standard scores based on the age range between 17 years and 0 month and 24 years and 11 months in the TOWRE-2 manual. Cronbach's alpha was 0.94.

Listening Comprehension

Listening comprehension was measured using a retired TOEFL test that included three listening segments (two dialogues and one lecture) and required participants to answer multiple-choice questions. The maximum score possible was 19 points. Cronbach's alpha was 0.55.

Background Questionnaire Survey

The survey was adapted from Miller (2013). It asked about participants' basic demographic information, English learning experiences, reading strategies, and word meaning inferencing strategies.

Data Collection and Analysis Procedures

A paper-and-pencil test battery consisting of the six instruments described above was administered to participants in a quiet classroom by the authors or four research assistants (two undergraduate students and two graduate students) trained for data collection. Listening comprehension, passage reading comprehension, and word meaning inferencing were tested in small groups first. Then participants completed the real word decoding and pseudoword decoding tests individually with a member of the research team. The tests took approximately 60–90 min to complete.

The real word decoding, pseudoword decoding, and word meaning inferencing data were first coded by the corresponding author and an undergraduate research assistant who was a native English speaker minoring in Linguistics. An agreement rate of 100% was

Table 1 Descriptive statistics of measures

Measure (Maximum score possible)	M	SD	95% CI
L1 morphosyllabary group (N = 25)			
Passage reading comprehension (14)	6.64	2.06	5.79, 7.49
Word meaning inferencing (18)	6.76	3.46	5.33, 8.19
Real word decoding efficiency standard score (130)	81.96	6.72	79.18, 84.74
Pseudoword decoding efficiency standard score (130)	74.16	8.50	70.65, 77.67
Listening comprehension (19)	11.36	2.22	10.45, 12.27
L1 alphabet group (N = 20)			
Passage reading comprehension (14)	7.00	3.08	5.56, 8.44
Word meaning inferencing (18)	8.70	3.96	6.85, 10.55
Real word decoding efficiency standard score (130)	87.45	12.29	81.70, 93.20
Pseudoword decoding efficiency standard score (130)	90.40	10.58	85.45, 95.35
Listening comprehension (19)	9.85	3.42	8.25, 11.45

reached for the first 10 participants' data (20%). The rest of the word decoding data were coded by the undergraduate research assistant.

To answer Research Question 1, descriptive statistics and MANOVA were conducted with passage reading comprehension, word meaning inferencing, real word decoding efficiency, pseudoword decoding efficiency, and listening comprehension as dependent variables and L1 writing system background as an independent variable. To answer Research Questions 2 and 3 respectively, correlation analyses (two-tailed Pearson correlation) and two sets of hierarchical regression models were carried out using SPSS Version 27 and macro program PROCESS Version 3.5 (Hayes, 2018) to explore the predictors of passage reading comprehension and word meaning inferencing in the respective L1 groups.

Results

Comparing L2 Reading Components Skills Between L1 Morphosyllabary and L1 Alphabet Learners

Descriptive statistics (standard scores for real and pseudoword decoding, and raw scores for other measures) are reported in Table 1. The accuracy rates of TOEFL reading comprehension and listening comprehension were above the chance level (i.e., 25%) in both the morphosyllabic L1 group and alphabetic L1 group (as illustrated in Fig. 1).

To answer Research Question 1, a MANOVA test[3] was conducted to compare the performance of the two L1 groups in passage reading comprehension, word meaning

[3] The statistical assumptions were checked to ensure the robustness of MANOVA test. The Shapiro–Wilk test suggested that every dependent variable was normally distributed ($p > 0.05$). Levene's Test of Equality of Error Variances showed the observed error variances of the dependent variables were generally equal across groups, except that some violation was found for listening comprehension ($p = 0.022$) and real word decoding ($p = 0.018$). The Pearson correlations indicated that the dependent variables were correlated moderately with each other (see Table 2). Box's Test of Equality of Covariance Matrices indicated that the covariance matrices between the groups were equal ($p = 0.256$). As a result, Pillais' Trace was used for data interpretation.

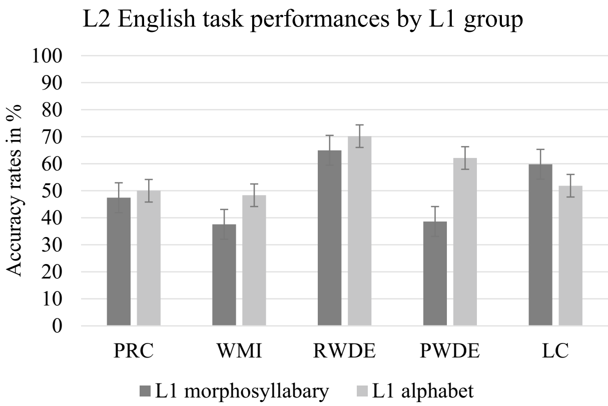

Fig. 1 L2 English task performances in the two L1 groups. *Note.* PRC, passage reading comprehension; WMI, word meaning inferencing; RWDE, real word decoding efficiency; PWDE, pseudoword decoding efficiency; LC, listening comprehension

inferencing, real word decoding efficiency, pseudoword decoding efficiency, and listening comprehension. The multivariate analysis results suggested that there was a statistically significant difference in task performance between the two L1 groups, $F_{1, 43} = 9.88$, $p < 0.000$). The effect size of this difference (partial $\eta^2 = 0.562$) was large according to Cohen (1969). Follow-up analyses indicated that there were no significant differences between the groups in passage reading comprehension, $F_{1, 43} = 0.22$, $p = 0.642$, partial $\eta^2 = 0.005$; word meaning inferencing, $F_{1, 43} = 3.08$, $p = 0.087$, partial $\eta^2 = 0.067$; listening comprehension, $F_{1, 43} = 3.20$, $p = 0.081$, partial $\eta^2 = 0.069$; or real word decoding efficiency, $F_{1, 43} = 3.64$, $p = 0.063$, partial $\eta^2 = 0.052$, yet there was a significant difference in pseudoword decoding efficiency with a large effect size, $F_{1, 43} = 32.61$, $p < 0.000$, partial $\eta^2 = 0.417$ (see also Fig. 1). Descriptive analysis results of the participants' word decoding percentile ranks can be found in "Appendix B". According to Torgesen et al. (1999), any score on the TOWRE-2 below the 25th percentile warrants word reading intervention. The L1 morphosyllabary learners were below the 25th percentile in both real and pseudoword decoding efficiency tests; the L1 alphabet learners were near or above the 25th percentile.

In sum, to answer Research Question 1, the two L1 groups were matched in both L2 English reading comprehension outcomes (passage reading comprehension and word meaning inferencing); there was no significant difference between the two L1 groups in real word decoding efficiency or linguistic comprehension; the alphabetic L1 group was more efficient in decoding English pseudowords than the morphosyllabic L1 group.

Contributions of L2 Component Skills to Reading Comprehension Among Learners with a Morphosyllabic L1

Correlation analysis results are shown in Table 2. For learners with a morphosyllabic L1, passage reading comprehension correlated significantly with real and pseudoword decoding efficiency, $r = 0.42$, $p = 0.037$ and $r = 0.55$, $p = 0.004$, respectively; word meaning inferencing also correlated significantly with real word decoding efficiency, $r = 0.60$, $p = 0.002$, and pseudoword decoding efficiency, $r = 0.54$, $p = 0.005$. There were small, non-significant correlations between reading comprehension and listening comprehension, $r = 0.31$, $p = 0.128$, and between word meaning inferencing and listening comprehension, $r = 0.28$, $p = 0.169$.

Table 2 Bivariate correlations among measures in L1 morphosyllabary learners (N = 25)

Measures	RWDE	PWDE	LC	PRC	WMI
RWDE	–	–	–	–	–
PWDE	.68**	–	–	–	–
LC	.34	.29	–	–	–
PRC	.42*	.55**	.31	–	–
WMI	.60**	.54**	.28	.49*	–

RWDE, real word decoding efficiency scaled score; PWDE, pseudoword decoding efficiency scaled score; LC, listening comprehension; PRC, passage reading comprehension; WMI, word meaning inferencing

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

Table 3 Hierarchical regression results with passage reading comprehension as the criterion variable (L1 morphosyllabary learners; N = 25)

Model 1	*R*	R^2	ΔR^2	*B*	*SE*	*β*	*t*	*Sig*
Step 1	.55	.30	.30					
PWDE				.13	.04	.55	3.16	.004
Step 2	.55	.31	.00					
PWDE				.12	.06	.49	2.04	.054
RWDE				.03	.07	.09	.36	.721
Step 3	.58	.33	.02					
PWDE				.115	.06	.47	1.95	.065
RWDE				.014	.08	.05	.180	.859
LC				.149	.18	.16	.843	.409

RWDE real word decoding efficiency scaled score, *PWDE* pseudoword decoding efficiency scaled score, *LC* listening comprehension

**$p < .01$

Hierarchical regression analysis was performed to examine the effects of real and pseudoword decoding efficiency as well as listening comprehension on passage reading comprehension (see Model 1 in Table 3). We entered predictors in the regression model with lower-level skills first, followed by higher-order skills (i.e., pseudoword decoding efficiency first, followed by real word decoding efficiency and listening comprehension). It should be that although both the pseudoword and real word decoding tasks measured lower-level skills, the pseudoword decoding task measured phonemic decoding whereas the real word decoding task measured sight word reading ability, and thus these capture readers' ability to retrieve sounds from printed words at different grain size levels (i.e., phoneme versus intrasyllable or syllable levels, respectively; see Ziegler & Goswami's, 2005 psycholinguistic grain size theory). We thus entered pseudoword decoding efficiency first. Multicollinearity did not occur in terms of variance inflation factors (all VIFs < 10 and Tolerance indices > 0.20) and correlation among all variables (all *r*s < 0.90) (Field, 2009). We then analyzed another regression model exploring the interaction effect between pseudoword and real word decoding efficiency on passage reading comprehension, which was not significant (see Model 2 in "Appendix C"), $F_{1, 20} = 0.04$, $p = 0.848$. The results of Model 1 as illustrated in Table 3 are discussed henceforth.

Table 4 Hierarchical regression results with word meaning inferencing as the criterion variable (L1 morphosyllabary learners; N = 25)

Model 1	R	R^2	ΔR^2	B	SE	β	t	Sig
Step 1	.54	.30	.30					
PWDE				.22	.07	.54	3.10	.005
Step 2	.63	.39	.10					
PWDE				.10	.09	.25	1.13	.272
RWDE				.22	.12	.43	1.89	.072
Step 3	.63	.40	.005					
PWDE				.10	.09	.25	1.07	.298
RWDE				.21	.12	.41	1.73	.098
LC				.12	.28	.08	.41	.683

As shown in Table 3, when pseudoword decoding efficiency was entered into the regression in Step 1, it was a significant predictor and explained about 30% of the variance in passage reading comprehension, $F_{1,\ 23} = 10.01$, $p = 0.004$. Real word decoding efficiency and listening comprehension did not make any significant contribution in Step 2 ($p = 0.721$) and Step 3 ($p = 0.409$), respectively. According to Plonsky and Ghanbar (2018), an R^2 smaller than 0.10 or 0.18 is considered small or moderate, respectively. Regression models explaining more than 50% of the variance are considered fairly robust. In this regard, the variance ($R^2 = 0.33$ in Step 3) explained by our model was moderate.

We then applied similar regression analyses with word meaning inferencing as the criterion variable. Again, we examined multicollinearity and ran another regression model exploring the interaction effect between pseudoword and real word decoding efficiency on word meaning inferencing, which was not significant (see Model 2 in "Appendix D"), $F_{1,\ 20} = 0.24$, $p = 0.626$. The results of Model 1 are presented in Table 4.

With word meaning inferencing as the outcome variable, the regression results in Table 4 indicate that, when pseudoword decoding was entered in Step 1, it had a significant effect on word meaning inferencing ($p = 0.005$), and explained approximately 30% of the variance; real word decoding efficiency and listening comprehension did not make any additional significant contribution in Step 2 ($p = 0.072$) and Step 3 ($p = 0.683$), respectively. The variance ($R^2 = 0.40$ in Step 3) explained by our model was moderate.

To sum up, in response to Research Question 2, in readers of L2 English with a morphosyllabic L1, pseudoword decoding efficiency was the only significant predictor of passage reading comprehension and word meaning inference, accounting for approximately 30% of the variance in both L2 reading comprehension and word meaning inference. On the other hand, there was no significant additional contribution of linguistic (listening) comprehension and real word decoding efficiency to either reading comprehension or word meaning inferencing in L2 English learners with a morphosyllabic L1.

Contributions of L2 Component Skills to Reading Comprehension Among Learners with an Alphabetic L1

The same statistical analysis procedures were applied in response to Research Question 3; correlational analysis was carried out first, followed by regression analyses.

As shown in Table 5 above, for learners with an alphabetic L1 background, passage reading comprehension was significantly correlated with all three predictors, namely pseudoword decoding efficiency, $r = 0.58$, $p = 0.008$; real word decoding efficiency, $r = 0.51$,

Table 5 Bivariate correlations among measures in L1 alphabet learners (N = 20)

Measures	RWDE	PWDE	LC	PRC	WMI
RWDE	–	–	–	–	–
PWDE	.75**	–	–	–	–
LC	− .03	.08	–	–	–
PRC	.51*	.58**	.48*	–	–
WMI	.48*	.49*	.18	.47*	–

RWDE, real word decoding efficiency scaled score; PWDE, pseudoword decoding efficiency scaled score; LC, listening comprehension; PRC, passage reading comprehension; WMI, word meaning inferencing

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

Table 6 Hierarchical regression results with passage reading comprehension as the criterion variable (L1 alphabet learners; N = 20)

Model 1	*R*	R^2	ΔR^2	*B*	*SE*	*β*	*t*	*Sig*
Step 1	.58	.33	.33					
PWDE				.17	.06	.58	3.01	.01
Step 2	.59	.35	.01					
PWDE				.13	.09	.45	1.51	.15
RWDE				.04	.07	.17	.57	.58
Step 3	.74	.55	.21					
PWDE				.10	.07	.34	1.31	.21
RWDE				.07	.06	.27	1.06	.31
LC				.41	.15	.46	2.72	.02

$p = 0.022$; and listening comprehension, $r = 0.48$, $p = 0.032$. Word meaning inferencing was significantly correlated with pseudoword decoding efficiency, $r = 0.49$, $p = 0.029$, and real word decoding efficiency, $r = 0.48$, $p = 0.030$, but not with listening comprehension, $r = 0.18$, $p = 0.440$. Listening comprehension did not corelate significantly with real word decoding efficiency, $r = -0.03$, $p = 0.889$, or pseudoword decoding efficiency, $r = 0.08$, $p = 0.732$. Hierarchical regression models were then run (see Model 1 without interaction between pseudoword and real word decoding efficiency in Table 6).

The results in Table 6 showed that when pseudoword decoding efficiency was entered in Step 1, it was a significant predictor of passage reading comprehension and explained approximately 33% of the variance, $F_{1, 18} = 9.05$, $p = 0.008$; when real word decoding efficiency was entered in Step 2, there was no additional significant effect, $F_{2, 17} = 0.325$, $p = 0.576$; finally, listening comprehension had a significant effect over and above real and pseudoword decoding efficiency, $F_{3, 16} = 7.42$, $p = 0.015$, explaining an additional 21% of the variance in passage reading comprehension, which was moderate.

Similar regression analysis procedures were adopted with word meaning inferencing as the outcome variable. The results are shown in "Appendix E". Notably, the interaction effect between pseudoword and real word decoding efficiency on word meaning inferencing was significant, $F_{1, 15} = 10.46$, $p = 0.006$, over and above the additive effects of pseudoword and real word decoding efficiency as well as listening comprehension.

As shown in Table 7, based on additional moderator analysis via the macro program PROCESS, there were significant effects of real word decoding efficiency and the

Table 7 Moderation regression modeling results with PWDE as the moderator (L1 alphabet learners; N = 20)

Model summary						
R	R^2	MSE	*F*	df1	df2	*p*
.77	.59	8.21	5.33	4	15	.007
Model	Coefficient	SE	*t*	*p*	LL 95%CI	UL 95%CI
Constant	− 124.50	18.91	− 6.58	.000	− 164.80	− 84.20
RWDE	1.48	.21	6.91	.000	1.02	1.93
PWDE	1.26	.24	5.22	.000	.75	1.78
RWDE * PWDE	− .01	.002	− 6.04	.000	− .02	− .01
LC	.24	.22	1.10	.29	− .23	.71

RWDE, real word decoding efficiency scaled score; PWDE, pseudoword decoding efficiency scaled score; LC, listening comprehension

Table 8 Conditional effects of real word decoding efficiency at -1SD, mean, and + 1SD of pseudoword decoding efficiency (L1 alphabet learners; N = 20)

	PWDE	Effect	SE	*t*	*p*	LLCI	ULCI
− 1SD	79.82	.35	.11	3.10	.007	.11	.59
Mean	90.40	.20	.09	2.30	.036	.02	.39
+ 1SD	100.99	.05	.08	.66	.521	− .12	.23

PWDE, pseudoword decoding efficiency scaled score

interaction between pseudoword and real word decoding efficiency on word meaning inferencing (without the 95% CI crossing zero), and a nonsignificant effect of listening comprehension. The R^2 change of the overall model was 0.59 and was significant, $F_{4,\,15} = 5.33$, $p = 0.007$. The model explained 59% of the variance associated with word meaning inferencing, which was fairly robust (Plonsky & Ghanbar, 2018).

We further probed the significant conditional effect(s) of real word decoding efficiency under the influence of pseudoword decoding efficiency using the SPSS macro program PROCESS Version 3.5 (Hayes, 2018), with word meaning inferencing as the criterion variable, real word decoding efficiency as the independent variable, pseudoword decoding efficiency as the moderator variable, and listening comprehension as the covariate. The analysis combined the pick-a-point approach (illustrated in Table 8 and Fig. 2) and Johnson–Neyman approach.

As shown in Table 8 and Fig. 2, the effect of real word decoding efficiency on word meaning inferencing was only significant for alphabetic L1 readers with weaker L2 English pseudoword decoding efficiency (1 SD below mean). In other words, for alphabetic L1 readers with weak pseudoword decoding efficiency in L2 English, the more efficient they were in L2 English real word decoding, the more accurate they were in L2 English word meaning inferencing. The Johnson-Neyman approach was applied to probe the moderator value around which the effect of real word decoding on word meaning inferencing was significant (as shown in "Appendix F"). It was found that when the value of pseudoword decoding efficiency standard score was below 91.79, the correlation between real word decoding and word meaning inferencing was significant (without the 95% CI crossing

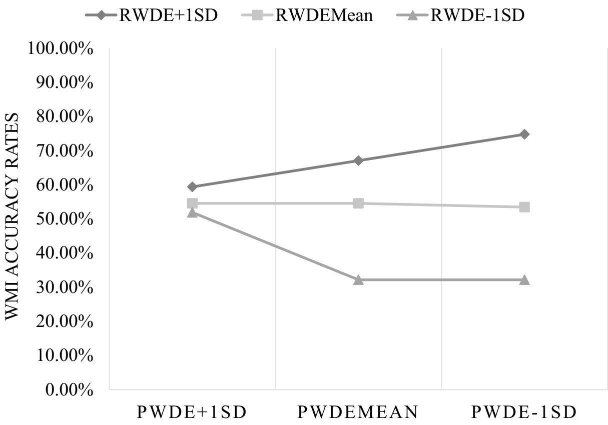

Fig. 2 The effect of read word decoding on word meaning inferencing moderated by pseudoword decoding. *Note*. PWDE, pseudoword decoding efficiency; RWDE, real word decoding efficiency; WMI, word meaning inferencing

zero), and 55% of the pseudoword decoding efficiency values in our dataset were below this value.

In summary, to answer Research Question 3, for learners of English with an alphabetic L1 background, linguistic (listening) comprehension was a significant predictor of passage reading comprehension and explained approximately 21% of the variance beyond real and pseudoword decoding efficiency. With word meaning inferencing as the target outcome and listening comprehension as a covariate, real and pseudoword decoding efficiency jointly explained about 59% of the variance in word meaning inferencing. Specifically, pseudoword decoding efficiency moderated the effect of real word decoding efficiency on word meaning inferencing: for L1 alphabet learners with weaker pseudoword decoding efficiency in L2 English, real word decoding efficiency affected word meaning inferencing significantly and positively.

Discussion

This study aimed to unveil the critical components underlying L2 reading comprehension by validating the SVR in L2 English readers of two different L1 writing system backgrounds (i.e., morphosyllabary and alphabet). We measured participants' real word and pseudoword decoding efficiency (with a standardized TOWRE-2 test), linguistic comprehension (with a TOEFL listening comprehension test), and two reading comprehension related outcomes (i.e., TOEFL passage reading comprehension and a researcher-designed word meaning inferencing task). There were two major findings: (1) When passage reading comprehension was the outcome, the critical predictor differed between the two L1 groups: for learners with a morphosyllabic L1, pseudoword decoding was the significant predictor, and there was no additional significant contribution from real word decoding or linguistic comprehension; for learners with an alphabetic L1, linguistic comprehension contributed significantly over and above real and pseudoword decoding efficiency. (2) When word meaning inferencing was the outcome, for learners with a morphosyllabic L1, pseudoword decoding efficiency was the sole significant predictor; for those with an alphabetic L1 who had weaker pseudoword decoding efficiency, real word decoding efficiency correlated positively and significantly with word meaning inferencing.

The first finding could shed light on the aggregating evidence regarding the impact of L1 writing system background and literacy experience on L2 reading. We observed that both pseudoword decoding and linguistic comprehension correlated significantly with L2 English reading comprehension in the alphabetic L1 group and that linguistic comprehension was a stronger predictor of L2 English reading comprehension, which was consistent with the findings of prior studies in L1 alphabetic L2 English learners (e.g., Erbeli & Joshi, 2022; Ghaedsharafi & Yamini, 2011; Kang, 2020) and L1 English learners of a transparent alphabetic L2 (e.g., Sparks & Luebbers, 2018). In comparison, pseudoword decoding was the only significant predictor of L2 English reading comprehension in the morphosyllabic L1 group, and linguistic comprehension did not have a significant effect. One possible explanation was that, due to the distance between the participants' L1 (i.e., morphosyllabic Chinese) and the L2 (i.e., alphabetic English), the linkage between oral language competence (i.e., linguistic comprehension) and written language competence (i.e., reading comprehension) could be weak (see also Uchikoshi, 2013).

Notably, our finding about the relative contribution of decoding and linguistic comprehension to reading comprehension in non-alphabetic L1 learners of English partially corroborated Brown and Haynes (1985). They found that listening and reading comprehension were correlated strongly for the alphabetic L1 ESL learners, while this correlation was nonsignificant for Japanese ESL learners. However, the results were inconsistent with the findings reported by Hamada and Koda (2010) and Jiang (2016). Hamada and Koda (2010) found that neither real word nor pseudoword decoding efficiency was significantly correlated with reading comprehension for L1 Chinese ESL learners. In addition, Jiang (2016) found that decoding, operationalized as oral language accuracy and efficiency, was not a significant predictor of reading comprehension of the Chinese ESL group, but contributed significantly among the Arabic and Spanish ESL learners. It should be noted that the results reported by Hamada and Koda (2010) were based on correlational analysis. In Jiang (2016), decoding was measured using passage-level reading materials (words correct per minute), but we measured single word reading in this study. In addition, L2 proficiency was found to moderate the relationships between different components and reading measures (e.g., Xue, 2021). The differences in English language proficiency levels might have led to the different patterns noted above. Though it is hard to compare the L2 proficiency levels across studies, it is possible that the L1 morphosyllabary/Chinese participants recruited from the English bridge programs in this research have not crossed the decoding threshold (Wang et al., 2019), and still need to develop their English decoding skills before an effect of linguistic comprehension on reading comprehension surfaces (see also Xue, 2021).

Other than the different passage reading comprehension component skills identified between the two L1 groups, we found a shared component skill in the two L1 groups when word meaning inferencing was considered as the reading outcome, namely pseudoword decoding efficiency. Specifically, pseudoword decoding efficiency was a significant predictor for the L1 morphosyllabary/Chinese learners, while in the alphabetic L1 group, the relationship between real word decoding efficiency and word meaning inferencing was moderated by pseudoword decoding efficiency: real word decoding efficiency was associated significantly with word meaning inferencing among learners with an alphabetic L1 whose pseudoword decoding efficiency was weaker (1 SD below the mean), but not for those with pseudoword decoding efficiency at the higher end (1 SD above the mean). These patterns differed from some previous empirical studies of L2 English readers. For example, Hamada and Koda (2010) found that, for L1 morphosyllabary/Chinese learners, neither real nor pseudoword decoding efficiency correlated with word meaning inference; for L1 alphabet/Korean learners, pseudoword decoding efficiency was related to word meaning inference. In Hamada and Koda (2010), the target items in the word meaning inference task were English pseudowords, while the target words in this research were real words. There is a need for future research to include both real and pseudowords in word meaning inferencing task design and examine potential task and reader effects.

Methodologically speaking, it should be noted that we relied on regression-based path models to generate profiles of L2 English readers, which is considered advantageous for studies with relatively small sample sizes (see Hayes, 2018). While previous adult L2 reading studies have mainly focused on gauging the L2 linguistic threshold for successful reading comprehension (including passage reading comprehension and word meaning inferencing), this research has identified the need for considering a L2 decoding threshold as well, even for learners of L2 English with an alphabetic L1. In the alphabetic L1 learner group, we identified weaker decoders with a cut score of 1.0 SD below the mean on the TOWRE–2 pseudoword decoding test. We noted that previous studies using standardized assessments have used a similar cut score analysis approach, and their study design was either longitudinal (e.g., Wang et al., 2019) or L1 norm-based (e.g., including an L1 comparison group, as in Sparks & Luebbers, 2018). Another modeling approach used in the literature was nonhierarchical k-means cluster analysis (e.g., Sparks et al., 2012). Cautions thus should be drawn about whether the TOWRE–2 pseudoword decoding subset cut score adopted in this study can be used as an index of a decoding threshold in university L2 English learners.

Taken together, our data supported the additive model of the SVR over the multiplicative model, as we found independent contributions of decoding and linguistic comprehension to reading with no interaction between them. This result corroborates prior studies such as Erbeli and Joshi (Erbeli & Joshi, 2022) and Sparks and Patton (2016). However, caution needs to be taken, as the results might be specific to the particular population at a particular developmental stage (see also Erbeli & Joshi, 2022). The multiplicative model might only be useful for participants who pass the linguistic or decoding thresholds. The interactional relationship between decoding and linguistic comprehension might not have emerged yet among our participants, who were relatively less proficient English learners. An important future direction would be to examine how language proficiency modulates the applicability of the SVR model for L2 learners with various L1 backgrounds.

Conclusion, Limitations, and Implications

To conclude, the SVR model was only partially validated in this research that examined the interrelationships among decoding (operationalized as real and pseudoword decoding efficiency), linguistic comprehension (operationalized as listening comprehension), and two reading comprehension-related outcomes (i.e., passage reading comprehension and word meaning inferencing) in L2 English readers of two different L1 writing system backgrounds (i.e., morphosyllabary and alphabet), who were recruited from American university English bridge programs. The two L1 learner groups did not differ significantly in their performance in reading comprehension, linguistic comprehension, or real word decoding efficiency; yet the alphabetic L1 group was stronger in pseudoword decoding efficiency than the morphosyllabic L1 group. When passage reading comprehension was examined as the outcome, the SVR model applied to L1 alphabet learners of L2 English only, for whom both decoding and linguistic comprehension contributed to passage reading comprehension, and linguistic comprehension played a more important role. In contrast, for learners of English with a morphosyllabic L1, pseudoword decoding efficiency was the only significant predictor and there was no additional contribution from linguistic comprehension. In this regard, when the SVR is applied to examine L2 reading development, modification may be needed to take into account the impact of L1–L2 writing system similarity/difference. Another unique finding of this research was that, when word meaning inferencing was treated as the outcome, pseudoword decoding efficiency was the only significant predictor among L1 morphosyllabary learners, and a significant moderator (of the relation between real word decoding efficiency and word meaning inferencing) in L1 alphabet learners, especially those with lower pseudoword decoding efficiency). The evidence seemed to suggest that pseudoword decoding efficiency was critical for both passage reading comprehension and word meaning inferencing in L2 English readers who have not transitioned from a sublexical processing to efficient lexical processing strategy (Schmidtke & Moro, 2020). In addition, the data in this study are better explained by an additive SVR model (Reading = Decoding + Linguistic Comprehension), rather than a multiplicative model (Reading = Decoding × Linguistic Comprehension).

Several limitations of this research should be acknowledged: One is related with the size and the composition of the participant pool. The languages in the alphabetic L1 group were mixed. Regarding the L1 mophosyllabary group, we only focused on learners with an L1 background as readers of simplified Chinese characters. More research is necessary to examine if the results are applicable to learners with an L1 background of traditional Chinese characters. Also, more background information of the participants (e.g., years of English learning) should be collected. Another limitation was that we did not measure reading subskills in the participants' L1. More detailed information about the L2 participants' L1 language and literacy experience needs to be gathered and documented in future research. We also would like to acknowledge that the sample size of this study was relatively small, and some of the task reliability indices were relatively low. According to Plonsky and Derrick (2016) the 25%, 50%, and 75% percentiles of instrument reliability coefficients in second language acquisition research are 0.74, 0.82, 0.89, respectively) and the median of second language acquisition research that focused on reading skills is 0.86. Our instrument reliability coefficients ranged from 0.55 to 0.94, with some instruments' reliability coefficients lower than those reported in second language acquisition research. As noted by Plonsky and Derrick (2016), L2 learners' overall L2 proficiency can affect task reliability (low L2 proficiency is correlated with low task reliability). Caution should be taken for future reading subskill assessment in adult L2 English learners. To further validate the SVR in L2 reading and develop a better understanding of learner individual differences in relation to learners' L1 writing system background and L2 decoding and linguistic profiles, there is a need to carry out (semi-)replication longitudinal research in a larger sample pool of participants with different reading comprehension tasks (e.g., tasks that measure both real and pseudoword meaning inferencing), control for other oral language skills (e.g., morphological awareness and syntactic awareness, as in Metsala et al., 2021), and include nonhierarchical statistical modeling such as k-means cluster analysis to identify L2 learners profiles (e.g., Sparks et al., 2012).

This study bears two important pedagogical implications. First, instruction focusing on linguistic comprehension (e.g., listening comprehension) alone might be insufficient for adult L2 reading comprehension development, as this study observed that phonological decoding (measured by pseudoword decoding efficiency) was critical for both passage reading comprehension and word meaning inferencing in L2 English learners enrolled in intermediate and advanced courses in American university bridge programs. Improving these learners' decoding efficiency might help them to connect printed words with spoken language and thus benefit from oral language comprehension instruction and self-teaching (Share, 1995). Second, although it is already known that learners' L1 writing system backgrounds and related literacy experiences have long-lasting impacts on L2 English reading development, educators should not simply profile learners who have an alphabetic L1 as more efficient decoders of L2 English than those with a morphosyllabic L1. According to the findings of this research, the two L1 groups did not differ significantly in their performance in real word decoding, reading comprehension, or word meaning inferencing, but varied only in the performance in pseudoword decoding. Furthermore, it was found that even within the alphabetic L1 learner group, some learners were weak in pseudoword decoding efficiency, which moderated the contribution of real word decoding efficiency to word meaning inferencing. It is thus essential for instructors to assess L2 English learners' decoding and linguistic profiles (see also Sparks & Luebbers, 2018) and determine whether supplementary decoding instruction is needed for intermediate and advanced learners in English bridge programs (see also Wang et al., 2019).

Appendix A

See Table 9.

Table 9 List of items in the word meaning inference task

Excess	Equipage	Obesity
Transitory	Hindrance	Deter
Overexert	Stationary	Wearied

Appendix B

See Table 10.

Table 10 Summary of the percentiles of real word decoding efficiency standard scores and pseudoword decoding efficiency standard scores

Measure	M	SD	95% CI
L1 morphosyllabary group ($N=25$)			
Percentile of RWDE	13.44	9.43	9.55, 17.33
Percentile of PWDE	6.44	7.41	3.39, 9.50
L1 alphabet group ($N=20$)			
Percentile of RWDE	24.75	22.11	14.40, 35.10
Percentile of PWDE	30	21.1	20.12, 39.88

Regarding the difference or lack of difference between real word decoding and pseudoword decoding standard scores, the score difference for the L1 morphosyllabary group was 7.8. Following the TOWRE-2 manual, we are about 80% confident that the difference was not due to measurement error. The score difference for the L1 alphabet group was −2.95. It could be possible that they had heightened phonological awareness with experiences in two alphabetic languages

Appendix C

See Table 11.

Table 11 Regression analysis with passage reading comprehension as the criterion variable and the interaction between PWDE and RWDE as predictor (L1 morphosyllabary learners; N = 25)

Model	Summary					
R	R-sq	MSE	*F*	df1	df2	*p*
.5757	.3314	3.4018	2.4784	4.0000	20.0000	.0770
Model						
	coeff	se	*t*	*p*	LLCI	ULCI
Constant	− 11.4408	34.9955	− .3269	.7471	− 84.4444	61.5627
RWDE	.0946	.4231	.2236	.8254	− .7880	.9772
PWDE	.2080	.4828	.4308	.6712	− .7991	1.2151
RWDE						
*PWDE	− .0011	.0057	− .1946	.8477	− .0130	.0108
LC	.1489	.1814	.8211	.4213	− .2294	.5273
Test(s) of highest order unconditional interaction(s)						
		R2-chng	*F*	df1	df2	*p*
RWDE * PWDE		.0013	.0379	1.0000	20.0000	.8477

RWDE real word decoding efficiency scaled score, *PWDE* pseudoword decoding efficiency scaled score, *LC* listening comprehension

Appendix D

See Table 12.

Table 12 Regression analysis with word meaning inferencing as the criterion variable and the interaction between PWDE and RWDE as predictor (L1 morphosyllabary learners; N = 25)

Model	Summary					
R	R-sq	MSE	*F*	df1	df2	*p*
.6368	.4055	8.5178	3.4106	4.0000	20.0000	.0279
Model						
	coeff	se	*t*	*p*	LLCI	ULCI
Constant	8.0298	55.3760	.1450	.8862	− 107.4892	123.5488
RWDE	− .1165	.6695	− .1740	.8637	− 1.5130	1.2801
PWDE	− .2746	.7639	− .3595	.7230	− 1.8682	1.3189
RWDE						
*PWDE	.0045	.0090	.4944	.6264	− .0144	.0233
LC	.1186	.2870	.4132	.6839	− .4801	.7173
Test(s) of highest order unconditional interaction(s)						
		R2-change	*F*	df1	df2	*p*
RWDE*PWDE		.0073	.2444	1.0000	20.0000	.6264

RWDE, real word decoding efficiency scaled score; PWDE, pseudoword decoding efficiency scaled score; LC, listening comprehension

Appendix E

See Table 13.

Table 13 Regression analysis with word meaning inferencing as the criterion variable (L1 alphabet learners; N = 20)

Model 1	*R*	R^2	ΔR^2	*B*	*SE*	*β*	*t*	*Sig*
Step 1	.49	.24	.24*					
PWDE				.18	.08	.49	2.38	.029
Step 2	.52	.27	.03					
PWDE				.11	.12	.29	.91	.375
RWDE				.09	.10	.27	.85	.408
Step 3	.55	.39	.03					
PWDE				.09	.12	.25	.76	.459
RWDE				.10	.10	.31	.95	.357
LC				.20	.25	.17	.82	.427
Step 4	.77	.59	.20**					
PWDE				1.26	.38	3.38	3.37	.004
RWDE				1.48	.43	4.58	3.40	.004
LC				.24	.20	.21	1.24	.233
PWDE* RWDE				− .01	.00	− 6.97	− 3.23	.006

RWDE real word decoding efficiency scaled score, *PWDE* pseudoworddecoding efficiency scaled score, *LC* listening comprehension

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

Appendix F

See Table 14.

Table 14 Conditional effect of real word decoding efficiency at values of pseudoword decoding efficiency

PWDE	Effect	SE	*t*	*p*	LLCI	ULCI
70.0000	.4906	.1465	3.3488	.0044	.1783	.8029
72.0000	.4625	.1394	3.3180	.0047	.1653	.7596
74.0000	.4343	.1325	3.2791	.0051	.1520	.7167
76.0000	.4062	.1257	3.2302	.0056	.1381	.6742
78.0000	.3781	.1193	3.1690	.0064	.1238	.6324
80.0000	.3499	.1132	3.0925	.0074	.1087	.5911
82.0000	.3218	.1074	2.9973	.0090	.0929	.5506
84.0000	.2937	.1020	2.8796	.0115	.0763	.5110
86.0000	.2655	.0971	2.7350	.0153	.0586	.4725
88.0000	.2374	.0927	2.5596	.0218	.0397	.4351
90.0000	.2093	.0891	2.3499	.0329	.0194	.3991
91.7904	.1841	.0864	2.1317	.0500	.0000	.3682
92.0000	.1811	.0861	2.1043	.0526	−.0024	.3646
94.0000	.1530	.0839	1.8234	.0882	−.0259	.3319
96.0000	.1249	.0826	1.5117	.1514	−.0512	.3009
98.0000	.0967	.0822	1.1769	.2576	−.0785	.2719
100.0000	.0686	.0827	.8294	.4199	−.1077	.2449
102.0000	.0405	.0841	.4811	.6374	−.1389	.2198
104.0000	.0123	.0864	.1428	.8884	−.1718	.1965
106.0000	−.0158	.0895	−.1766	.8622	−.2065	.1749
108.0000	−.0439	.0932	−.4711	.6443	−.2427	.1548
110.0000	−.0721	.0976	−.7380	.4719	−.2802	.1361

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Declarations

Conflict of interest None.

Ethical Approval The study has been approved by the IRB office of the University of Kentucky and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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