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Unpacking the Simple View of Reading for Struggling Adult Readers

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Abstract

The Simple View of Reading (SVR), which posits that reading comprehension is the product of decoding and linguistic comprehension, has been studied extensively with school-age readers. However, little is known about the intricacies of the SVR for adults who struggle with reading. The current study addresses notable gaps in this literature, including the dimensionality of linguistic comprehension, the interaction between the two SVR components, and the relative contributions of components across different reading proficiency levels. With a sample of 392 struggling adult readers, confirmatory factor analyses indicated that the linguistic comprehension component encompasses the highly related yet separable constructs of oral vocabulary and listening comprehension. Structural equation modeling showed significant main effects of decoding and listening comprehension, but not oral vocabulary, on reading comprehension. Additionally, the interaction between the SVR components did not uniquely contribute to variance in reading comprehension. Quantile regression models demonstrated that the unique effects of the SVR components were relatively stable in magnitude across different levels of reading comprehension performance. Implications for instruction and future research are discussed.

The Simple View of Reading (SVR) posits that variation in reading comprehension performance can be attributed to two component skills: decoding and linguistic comprehension (Gough & Tunmer, 1986). The contributions of decoding and linguistic comprehension to reading comprehension have been established for students in the first grade through graduate school (Carver, 1998; Catts et al., 2006; Chen & Vellutino, 1997; Hoover & Gough, 1990; Johnston & Kirby, 2006; Lonigan et al., 2018; Savage, 2006; Savage & Wolforth, 2007). Deficits in these components have also been used to identify specific reading problems in developing readers (Aaron et al., 2008; Catts et al., 2006).

Although the SVR may seem reductionist at first glance, researchers have noted its particular suitability for understanding the basic reading processes of readers with underdeveloped skills and identifying targets for reading instruction (Kim, 2017; Kirby & Savage, 2008; Stuart et al., 2008). Certainly, there are more complex frameworks that account for sources of variation in reading comprehension performance, including the Direct and Inferential Mediation Model that highlights the contributions of inferences and background knowledge (Cromley & Azevedo, 2007) and the cognitive view of reading that recognizes the importance of executive functioning and attentional processes (Kendeou et al., 2014). In contrast, the SVR is a uniquely parsimonious model and offers an appropriate starting point for studying reading challenges. With its focus on the fundamental process of mapping print onto spoken language, the SVR provides a valuable framework to understand the abilities of adults who struggle with reading, a population that includes about 19% of adults in the United States (National Center for Education Statistics, 2019) and 16% of adults in Canada (Organisation for Economic Co-operation and Development, 2013).

Multiple investigations involving struggling adult readers have demonstrated that the

SVR components account for the majority of variance in reading comprehension performance (Barnes et al., 2017; Braze et al., 2016; Sabatini et al., 2010; Talwar et al., 2018). However, certain aspects of the SVR have not been rigorously studied with this population, including the dimensionality of linguistic comprehension, the interaction between SVR components, and the stability of their explanatory effects at different reading proficiency levels. Our goal in this investigation was to address these empirical gaps and provide a clearer understanding of the SVR as it pertains to struggling adult readers, who may have diagnosed or undiagnosed learning disabilities (Greenberg, 2008; Mellard & Patterson, 2008).

The Structure of the Model

Across investigations with child, adolescent, and adult readers, the SVR components of decoding and linguistic comprehension have explained substantial variance in reading comprehension (Chen & Vellutino, 1997; Kendeou et al., 2009; Lonigan et al., 2018; Savage & Wolforth, 2007), even after controlling for other reading-related skills (Kershaw & Schatschneider, 2012; Silverman et al., 2013; Tilstra et al., 2009). Despite the rich history of research on the SVR, experts have noted the lack of a clear consensus on how to operationalize the component of linguistic comprehension (Kim, 2017; Tunmer & Chapman, 2012).

Linguistic comprehension has been defined as the ability to derive meaning from spoken words, sentences, and discourses (Hoover & Gough, 1990). With respect to struggling adult readers, the question remains whether linguistic comprehension is a unidimensional ability, or whether it encompasses multiple dimensions, with oral vocabulary representing meaning-making at the word level and listening comprehension representing meaning-making at the sentence and discourse level (Kim, 2017; Kirby & Savage, 2008; Tunmer & Chapman, 2012). Research with children suggests that oral vocabulary and listening comprehension tap into a shared latent ability (Kershaw & Schatschneider, 2012; Silverman et al., 2013; Tunmer & Chapman, 2012), although this is not a unanimous finding (Lonigan et al., 2018). Investigations with struggling adult readers have also reported mixed findings on this issue (Tighe, 2019). Braze et al. (2016) found support for a unidimensional linguistic comprehension construct, whereas Sabatini et al. (2010) reported an improvement in model fit when oral vocabulary and listening comprehension were represented as separate factors.

Originally, the SVR was proposed as a multiplicative model in which reading comprehension is predicted by the product of decoding and linguistic comprehension (Gough & Tunmer, 1986). This characterization is markedly different from a simple additive model of the SVR, which would suggest that reading comprehension is the result of the linear sum of the two components. The multiplicative model postulates an important interaction between decoding and linguistic comprehension that uniquely contributes to reading comprehension beyond the additive contributions of the two components (Chen & Vellutino, 1997; Kirby & Savage, 2008). In other words, neither component alone is sufficient for reading comprehension. If a reader can translate a text passage to oral language but cannot understand its meaning, reading comprehension will not occur. Similarly, if a reader understands the words and sentences used in a passage but cannot decode the text, reading comprehension will not occur.

Hoover and Gough (1990) provided support for this multiplicative model with English-Spanish bilingual children by showing that the product of decoding and linguistic comprehension contributed unique variance to reading comprehension beyond the contributions of the linear combination of the two components. Conversely, subsequent research with largely monolingual English-speaking children and adolescents demonstrates that the product of decoding and linguistic comprehension does not always uniquely explain a statistically or practically significant proportion of variance in reading comprehension (Chen & Vellutino, 1997; Dreyer & Katz, 1992; Kershaw & Schatschneider, 2012; Savage, 2006; Silverman et al., 2013). With struggling adult readers, past investigations have specified simple additive models for the SVR (Barnes et al., 2017; Braze et al., 2016; Sabatini et al., 2010), and have not explored whether the interaction between decoding and linguistic comprehension is uniquely predictive of reading comprehension.

The Importance of Component Skills across Reading Levels

Another important question pertaining to the SVR involves the relative importance of decoding and linguistic comprehension for reading at different proficiency levels. Prior research indicates that decoding is a stronger correlate of reading comprehension than linguistic comprehension at the beginning of elementary education, but that this relation declines as children advance through the elementary grades (Carver, 1998; Hoover & Gough, 1990; Kendeou et al., 2009). Cross-sectional investigations have shown that as grade level increases, the predictive utility of linguistic comprehension to reading comprehension increases and that of decoding decreases (Kershaw & Schatschneider, 2012; Lonigan et al., 2018; Tilstra et al., 2009; Vellutino et al., 2007). This observed trend may be explained by the verbal efficiency theory (Perfetti, 1985), which posits that lower-level processes (e.g., decoding) become automatized for advanced readers, thereby freeing up cognitive resources for higher-level skills (e.g., linguistic comprehension).

With struggling adult readers, there are mixed findings regarding the unique contributions of decoding and linguistic comprehension. Linguistic comprehension had a relatively larger effect on reading comprehension for adults reading between the first and tenth grade levels (Barnes et al., 2017) as well as for young adults in different educational programs whose reading levels were not reported (Braze et al., 2007, 2016). A different investigation showed that the effect of decoding on reading comprehension was relatively larger than those of vocabulary and listening comprehension for adults reading between the first and twelfth grade levels (Mellard et al., 2010). Yet another study found that both decoding and linguistic comprehension exhibited similar effects on reading comprehension (Sabatini et al., 2010). There appears to be no clear trend in the literature with respect to the unique effects of the two SVR components across the range of adult reading ability.

The Utility of Quantile Regression for the Simple View of Reading

In recent years, a handful of investigations have examined the contributions of decoding and linguistic comprehension across varying reading comprehension levels using quantile regression, a methodology that was initially used in econometrics research (Koenker & Basset, 1978). Quantiles refer to levels or “cut points” of a score distribution that are closely related to percentiles (Petscher & Logan, 2014). Quantile regression analyzes the effect of independent variables at multiple quantiles in the distribution of a dependent variable. Each effect is estimated by utilizing data from the entire sample and appropriately assigning weights to different data points (Petscher & Logan, 2014). This allows researchers to explore the relation between the independent and dependent variables across the full range of skill level. Such an approach could be especially useful with struggling adult readers, who comprise a largely heterogeneous population (Greenberg, 2008; Tighe, 2019).

Thus far, attempts to explore the SVR using quantile regression have been limited to school-age youth. With children in the third through fifth grades, Lonigan et al. (2018) observed that the unique effect of decoding was relatively stable across different quantiles of reading comprehension performance, whereas the unique effect of oral vocabulary appeared to be greater at higher quantiles. Because tests of between-quantile slopes were not reported, it cannot be determined whether the apparent increase in the importance of vocabulary for higher-level comprehenders was statistically significant.

Hua and Keenan (2017) explored the importance of word recognition and listening comprehension on five reading comprehension tests with two age groups of readers. For children eight through 10 years old, the unique effect of word recognition significantly declined between the .1 and .5 quantiles and between the .5 and .9 quantiles of the Woodcock Johnson III Passage Comprehension subtest (Woodcock et al., 2001). There was no statistically significant difference in the unique effects of listening comprehension for any reading comprehension test. For older readers who were between the ages of 10 and 18 years, no between-quantile differences were found in the unique effects of word recognition and listening comprehension on any of the five reading comprehension tests.

Another quantile regression study relevant to the SVR was conducted by the Language and Reading Research Consortium (LARRC) and Logan (2017) with third grade students. Although word reading and higher-level language exhibited approximately similar effects on reading comprehension for third graders at the .20 quantile of reading comprehension, the effect of word reading was significantly smaller at the .80 quantile whereas the effect of higher-level language remained stable across all quantiles. This finding, coupled with Hua and Keenan’s results for the WJ Passage Comprehension subtest, reflects the declining importance of decoding for more proficient readers in elementary school (Carver, 1998; Hoover & Gough, 1990).

The Current Study

The current study focused on evaluating the SVR with a sample of struggling adult readers with three main goals. The first goal was to explore the dimensionality of the linguistic comprehension construct for struggling adult readers. The second goal was to explore the predictive utility of the interaction or product of decoding and linguistic comprehension. The third goal was to systematically examine the unique contributions of decoding and linguistic comprehension as reading skill changes by estimating their effects at different reading comprehension quantiles. Quantile regression has been successfully applied with struggling adult readers in a previous study involving two component skills (Tighe & Schatschneider, 2016), but has not yet been extended to the SVR. This approach can provide novel insight into the skills that are important for struggling adult readers' reading comprehension performance across proficiency levels.

Three research questions guided our investigation:

1. For struggling adult readers, what is the dimensionality of the linguistic comprehension component of the Simple View of Reading?

2. Does the interaction between decoding and linguistic comprehension uniquely contribute to reading comprehension?

3. What are the effects of decoding and linguistic comprehension at relatively low, average, and high levels of reading comprehension performance?

Method

Participants

Data were collected as part of a larger research project (Institute of Education Sciences, U.S. Department of Education, Grant R305C120001). Participants were recruited from 35 adult literacy programs and included 392 native speakers of English who were enrolled in adult literacy classes targeting adults who read between the third and eighth grade levels in large cities in the southeastern United States (56.6%) and southern Canada (43.4%). The mean age of the sample was 36.99 years (*SD* = 14.85). The majority of the participants (61.5%) were women. Over two-thirds of the participants (69.9%) identified as Black and almost one quarter (23.7%) identified as White. Approximately 29% of participants reported that they had been previously tested for a learning disability. Participants were not asked about formal diagnoses of learning disabilities, as self-reported diagnoses can be unreliable among adult literacy learners (Mellard & Patterson, 2008). More detailed demographic information is reported in Table 1.

Procedure

Prior to collecting data from participants, each tester received training on administering each measure and completed multiple practice sessions with coworkers and supervisors. Testers also received sensitivity training to prepare them for interaction with adult literacy learners. Each tester's first data collection session was observed by an experienced staff member.

The larger study included a battery of more than 30 assessments, which were administered to the participant across multiple sessions, with each session occurring on a different day. Each individual session was no more than three hours long. All sessions were conducted in a one-on-one setting at the participant's adult literacy program. The items on all measures gradually increased in difficulty. All basal and ceiling rules were followed. Items were scored as correct or incorrect according to the instructions in the publishers' examiner manuals. All participant record forms underwent two rounds of scoring and a final check.

Measures

Many of the measures included in the current study have been previously administered to struggling adult readers to assess reading and language constructs (e.g., Mellard et al., 2016; Sabatini et al., 2010). We used multiple measures to assess each SVR component, as this approach was likely to circumvent the limitations of any one measure and reduce measurement error. We were able to include only one reading comprehension measure because only one measure was administered in the larger project. In this section, we report the internal consistency reliability estimates for the normative samples provided by the test publishers. The reliability estimates for the participants in the current study are reported in Table 2.

Reading Comprehension.

WJ Passage Comprehension. In the Passage Comprehension subtest of the Woodcock Johnson (WJ) III Normative Update (Woodcock et al., 2007), the items were connected texts consisting of one or two sentences and a blank indicating a missing word. The participant was asked to verbally provide the missing word. Administration started at Item 14. This measure was standardized on individuals 2 years old to over 80 years old, and internal consistency reliability ranges from .73 to .96 (McGrew et al., 2007).

Decoding.

WJ Letter-Word Identification. In the WJ Letter-Word Identification subtest, the participant read real words out loud. Administration started at Item 33. This measure was standardized on individuals 2 years old to over 80 years old, and internal consistency reliability ranges from .88 to .99 (McGrew et al., 2007).

Test of Irregular Word Reading. In the Test of Irregular Word Reading (TIWRE; Reynolds & Kamphaus, 2007a), the participant was presented with a list of words and was asked to read out loud as many as possible. All of the words involved irregular spellings and could not be sounded out using conventional phonetic rules. Administration started with the first word item. This measure was standardized on individuals 3 to 94 years old, and internal consistency reliability ranges from .88 to .96 (Reynolds & Kamphaus, 2007b).

WJ Word Attack. In the WJ Word Attack subtest, the participant read aloud pseudowords. Administration started at Item 4. This measure was standardized on individuals 4 years old to over 80 years old, and internal consistency reliability ranges from .78 to .94 (McGrew et al., 2007).

Listening Comprehension.

WJ Story Recall. In the WJ Story Recall subtest, the examiner played audio recordings of very short stories and the participant retold each story out loud as accurately as possible. Administration started at Story 5. This measure was standardized on individuals 2 years old to over 80 years old, and internal consistency reliability ranges from .56 to .90 (McGrew et al., 2007).

WJ Understanding Directions. In the WJ Understanding Directions subtest, the examiner played audio recordings instructing participants how to point to different parts of an accompanying picture. The participant carried out each set of instructions. Administration started at Picture 2. This measure was standardized on individuals 2 years old to over 80 years old, and internal consistency reliability ranges from .62 to .93 (McGrew et al., 2007).

CELF Understanding Spoken Paragraphs. In the Understanding Spoken Paragraphs subtest of the Clinical Evaluation of Language Fundamentals IV (CELF; Semel et al., 2003a), the examiner read aloud very short stories and the participant answered questions about the content of the stories. Administration started at Item 1 of Set 1. This measure was standardized on individuals 5 to 21 years old, and internal consistency reliability ranges from .54 to .81 (Semel et al., 2003b).

Oral Vocabulary.

CELF Word Classes. In the Word Classes subtest of the Clinical Evaluation of Language Fundamentals IV (CELF; Semel et al., 2003a), the examiner read four words out loud for each item. The participant selected two words that were related and then explained their relationship. Administration started at Item 1. This measure was standardized on individuals 5 to 21 years old, and internal consistency reliability ranges from .83 to .94 (Semel et al., 2003b).

CELF Word Definitions. In the CELF Word Definitions subtest, the examiner read out a word and used it in a sentence for each item. The participant orally provided a definition of the word. Administration started at Item 1. This measure was standardized on individuals 10 to 21 years old, and internal consistency reliability ranges from .85 to .89 (Semel et al., 2003b).

WJ Picture Vocabulary. In the WJ Picture Vocabulary subtest, the participant named objects or actions depicted in pictures. Administration started at Item 15. This measure was standardized on individuals 2 years old to over 80 years old, and internal consistency reliability ranges from .70 to .93 (McGrew et al., 2007).

Data Analysis Strategy

Approximately 20% of participants had missing data on at least one measure. Little's test indicated that these data were missing completely at random ($p > .05$). In addition, a total of 33 univariate outliers were identified and brought within the limits of ± two interquartile ranges. Data on each measure exhibited a normal distribution, as indicated by univariate skewness and kurtosis values between ±1.

We used raw scores in the analyses. Confirmatory factor analysis (CFA) and structural equation modeling were used to address the first two research questions. In line with these approaches, the SVR components were modeled as latent factors. To handle missing data, full information maximum likelihood (ML) was used as the estimation method (Enders & Bandalos, 2001). Model fit indices were evaluated using Hu and Bentler's (1999) recommendations for ML-based models, which suggest that good fit is indicated by Comparative Fit Index (CFI) and

Tucker-Lewis Index (TLI) values greater than .95, Root Mean Square Error of Approximation (RMSEA) values less than .06, and Standardized Root Mean Square Residual (SRMR) values less than .08.

Quantile regression was used to address the third research question. Following Hua and Keenan's (2017) quantile regression approach, the SVR predictors were represented by composites of observed variables and the low, average, and high levels of reading comprehension performance were respectively operationalized as the .1, .5, and .9 quantiles of performance on the WJ Passage Comprehension subtest.

Results

Participants' performance on all measures is reported in Table 2. The Cronbach's alpha estimates in this table are based on participants' item performance. As reported in Table 3, bivariate correlations across measures ranged from .117 to .828.

Research Question 1: For struggling adult readers, what is the dimensionality of linguistic comprehension?

To answer the first research question, a series of CFA models were estimated using Mplus 8.1 (Muthén & Muthén, 1998-2017). The fit indices for all models are reported in Table 4.

In Model 1, all six measures of linguistic comprehension were loaded on one latent factor (see Figure 1). All factor loadings were significant (*p*s < .001) and standardized estimates ranged from .60 to .75. This model exhibited acceptable fit to the data ($\chi^2(9) = 40.7$, $p < .001$, CFI = .959, TLI = .931, RMSEA = .095, SRMR = .0.37, AIC = 5575, and BIC = 5647). Since the RMSEA and TLI values did not meet Hu and Bentler's (1999) criteria, an alternative model was examined next.

In Model 2, a two-factor CFA was estimated for linguistic comprehension. The three listening comprehension measures and the three oral vocabulary measures were loaded on separate factors (see Figure 2). All factor loadings were significant (*p*s < .001) and standardized estimates ranged from .65 to .78. This model exhibited excellent fit ($\chi^2(8) = 15.8$, $p = .045$, CFI = .990, TLI = .981, RMSEA = .05, SRMR = .022, AIC = 5552, and BIC = 5628). Moreover, a chi-square difference test indicated that this two-factor model for linguistic comprehension provided a significantly better fit to the data than the one-factor model, ($\chi^2(1) = 24.9$, $p < .001$). Thus, this representation of linguistic comprehension was retained.

Model 3 included both the decoding and linguistic comprehension components of the SVR. A three-factor CFA was estimated, with decoding measures, listening comprehension measures, and oral vocabulary measures loaded on separate factors (see Figure 3). All factor loadings were significant (*p*s < .001) and standardized estimates ranged from .65 to .94. The model provided a good fit to the data ($\chi^2(24) = 59.6$, $p < .001$, CFI = .978, TLI = .967, RMSEA = .062, SRMR = .040, AIC = 7860, and BIC = 7980). This latent structure of the SVR components was retained for subsequent analyses.

Research Question 2: Does the interaction between decoding and linguistic comprehension uniquely contribute to reading comprehension?

To answer the second research question, three structural equation models (SEMs) were estimated. The fit indices for all models are reported in Table 4.

The predictors in Model 4 were the latent factors of decoding, oral vocabulary, and listening comprehension estimated in Model 3, and the criterion was reading comprehension as indexed by WJ Passage Comprehension (see Figure 4). Decoding and listening comprehension exhibited significant unique effects on reading comprehension (*p*s < .01), but the unique effect of oral vocabulary was not significant ($p > .05$). This model accounted for 67.5% of the variance in reading comprehension scores. Approximately 12.6% of the variance in reading comprehension was uniquely explained by decoding and 3.4% was uniquely explained by listening comprehension.

Our next goal was to augment the SEM to account for the interaction between the linguistic comprehension and decoding components, which is posited in the multiplicative model of the SVR (Gough & Tunmer, 1986). Since the previous CFAs suggested that linguistic comprehension encompassed two separable latent factors, we estimated the interaction between decoding and listening comprehension in one model (Model 5) and the interaction between decoding and oral vocabulary in a separate model (Model 6).

In Model 5, the predictors were latent factors of decoding, oral vocabulary, and listening comprehension as main effects, as well as the interaction between decoding and oral vocabulary. Decoding and listening comprehension exhibited significant unique main effects on reading comprehension (*p*s < .01), but the main effect of oral vocabulary was not significant ($p > .05$). The interaction was also not significant ($p > .05$). The variance in reading comprehension explained by this model was 67.6%, which is nearly identical to Model 4 and suggests that the interaction between decoding and oral vocabulary did not make a unique contribution to reading comprehension.

Similarly, the predictors in Model 6 were latent factors of decoding, oral vocabulary, and listening comprehension as main effects, as well as the interaction between decoding and listening comprehension. As with Model 5, decoding and listening comprehension exhibited significant unique effects on reading comprehension (*p*s < .01), but the main effect of oral vocabulary was not significant ($p > .05$). The interaction was also not significant ($p > .05$). This model explained the same proportion of variance in reading comprehension as Model 4 (67.5%), which indicates that the interaction between decoding and listening comprehension did not uniquely contribute to the variance in reading comprehension.

Research Question 3: What are the effects of the Simple View of Reading predictors at low, average, and high levels of reading comprehension performance?

To answer the third research question, a quantile regression model was estimated using Stata 15 (StataCorp, 2017). This model did not include any interaction terms because the SEM results indicated that the interaction between decoding and linguistic comprehension factors did not increase the explanatory power of the SVR for struggling adult readers. Therefore, the predictors in the quantile regression model were based on Model 4. Composites were computed for decoding, listening comprehension, and oral vocabulary by taking the average of z-scores on the relevant measures. (For example, the decoding composite was the mean of z-scores on WJ Letter-Word Identification, WJ Word Attack, and TIWRE.) The decoding, listening comprehension, and oral vocabulary composites served as the predictors in the quantile regression. The criterion was reading comprehension as indexed by WJ Passage Comprehension, and the model parameters were estimated at the .1, .5, and .9 quantiles of the score distribution.

The quantile regression results are reported in Table 5. All three predictors exhibited unique significant effects on reading comprehension at the .1, .5, and .9 quantiles (*p*s < .05). This finding differs from the SEM results, in which oral vocabulary did not emerge as a significant predictor. This discrepancy may be due to the fact that the SVR predictors were represented differently in the two analytic approaches. These constructs were modeled as latent variables in the SEM and as composites of observed scores in the quantile regression analyses.

Between-quantile slope comparisons were conducted across the .1, .5, and .9 quantiles. No significant differences were found (*p*s > .05). This indicates that the unique effects of decoding, listening comprehension, and oral vocabulary were stable across low, average, and high levels of reading comprehension performance for this sample of struggling adult readers. Figures 5, 6, and 7 show the unique slope estimates of each independent variable at nine equidistant quantiles.

Discussion

The SVR has been widely used to model reading comprehension across various age groups (Kershaw & Schatschneider, 2012; Savage & Wolforth, 2007; Silverman et al., 2013; Vellutino et al., 2007). The model provides a useful framework for understanding the sources of reading comprehension difficulties among low-skilled readers (Kirby & Savage, 2008). The main aim of the current study was to unravel the complexities of the SVR for struggling adult readers who are native English speakers and read approximately between the third and eighth grade levels. The results offer evidence against treating the SVR as a multiplicative model and linguistic comprehension as a unidimensional component for this population. Furthermore, the SVR components appear to be uniform predictors of reading comprehension across the spectrum of proficiency represented in the sample. Overall, decoding emerged as the strongest predictor of reading comprehension, which suggests that decoding deficits are the main source of reading difficulties for struggling adult readers.

The dimensionality of linguistic comprehension supported by the data (see Figure 3) is similar to Sabatini et al.'s (2010) latent SVR model for adult literacy learners reading below the seventh grade level, which separated the oral vocabulary and listening comprehension factors. In contrast, Braze et al. (2016) found support for a unidimensional linguistic comprehension factor for individuals with unreported reading levels enrolled in adult education programs, high school, and community college. Perhaps the difference in findings can be attributed to the inclusion of high school students in Braze et al.'s sample; the integration of oral language skills observed with school-age readers (e.g., Kershaw & Schatschneider, 2012; Tunmer & Chapman, 2012) would not necessarily apply to the struggling adult reader population (Nanda et al., 2010).

In the SEM (see Figure 4), the SVR components accounted for approximately two-thirds of the total variance (67.5%) in reading comprehension for our sample. This is in line with previous studies reporting the variance explained by SVR models (58-69%) with struggling adult readers (Braze et al., 2016; Sabatini et al., 2010). Decoding made the largest unique contribution to reading comprehension performance. This finding is in agreement with Mellard et al.'s (2010) results and may have been influenced by the partial overlap in measures across the two studies. In terms of the linguistic comprehension subcomponents, only listening comprehension exhibited a significant effect on reading comprehension, which is similar to Sabatini et al.'s (2010) SEM findings. It is likely that the unique influence of oral vocabulary was suppressed due to the high correlation with listening comprehension in both the current study and Sabatini et al.'s investigation (*r*s > .80).

We did not find any evidence to suggest a multiplicative relationship between decoding and linguistic comprehension for our sample. The multiplicative models, which included interactions between the components, were no better than the additive model at explaining variability in reading comprehension performance. This echoes findings reported in past investigations with monolingual English-speaking readers in elementary and secondary school (Dreyer & Katz, 1992; Kershaw & Schatschneider, 2012; Savage, 2006; Silverman et al., 2013). Perhaps the interaction between decoding and linguistic comprehension is predictive of reading comprehension only for readers who are proficient in another language in addition to English (Hoover & Gough, 1990).

Although cross-sectional research with school-age youth suggests that the relative contributions of SVR components change with reading level (e.g., Kershaw & Schatschneider, 2012; Tilstra et al., 2009), this trend was not reflected across the continuum of adult reading abilities represented in our sample. Interestingly, decoding explained the largest proportion of variance in reading comprehension at each quantile (see Table 5), which suggests that these adults are similar to young readers in elementary school for whom reading comprehension is more strongly related to decoding than to oral language skills (Hoover & Gough, 1990; Kendeou et al., 2009; Lonigan et al., 2018). These findings illustrate that the current sample of struggling adult readers substantially diverges from proficient adult readers, who would be expected to have automatized decoding abilities and whose reading comprehension performance would be largely influenced by higher-level language competencies (Kershaw & Schatschneider, 2012; Savage & Wolforth, 2007; Perfetti, 1985).

Implications

The SVR framework allows researchers to identify instructional targets that can build reading comprehension proficiency (Catts et al., 2006; Kirby & Savage, 2008). The current sample reflects the reading skill performance and associations that are typically observed with developing readers in elementary grades. The findings strongly highlight the importance of decoding for struggling adult readers. Decoding skills can be targeted in instruction within adult literacy programs. Evidence from multi-site interventions indicates that some adult literacy learners are responsive to curricula that include an intensive decoding component (Alamprese et al., 2011; Greenberg et al., 2019). These curricula can include topics like identifying phonemes, recognizing variable vowel sounds, and segmenting multisyllabic words. This type of instruction has led to gains on letter-sound knowledge, phonic decoding, and word reading. Results suggest that the benefits are greatest for specific subsets of the struggling adult reader population, such as native speakers of English (Alamprese et al., 2011) and adults with relatively lower decoding skills (Greenberg et al., 2019).

The current study's quantile regression results also point to the need to focus on oral language. Interventions targeting oral vocabulary knowledge have yielded large effect sizes with children (Scammacca et al., 2015) and may be similarly helpful for struggling adult readers. Curtis (2006) emphasizes different instructional strategies to build vocabulary in the adult classroom, such as analyzing contextual cues, decomposing words into roots and affixes, and eliciting definitions for particularly difficult words. Additionally, a specific focus on academic vocabulary may address an important gap in adult learners' lexicon (Pae et al., 2012; Strucker, 2013).

Beyond building vocabulary, adult literacy instruction can also support the development of higher-level oral language skills. Recommendations for teachers include facilitating group discussions in class and asking students to answer questions about an oral narrative (Bakhtiari et al., 2015). Teachers can also instruct learners in activating prior knowledge to facilitate deeper listening comprehension (Durgunoğlu et al., 2019). Furthermore, free podcasts can provide students access to high-quality spoken discourse outside of the classroom (Hasan & Hoon, 2013).

Limitations and Future Research

It is important to consider the limitations of the measures included in the current study. The CELF subtests were not normed on individuals older than 21 years. Thus, it is possible that the items on these measures were not psychometrically appropriate for adult examinees. Future research with exclusively adult-normed measures of oral language is warranted.

There are specific caveats to note regarding our assessment of listening comprehension. The measures used for this construct tapped into working memory capacity. Participants were expected to recall details from narratives and remember complex sets of instructions. This working memory demand may have placed additional stress on cognitive resources and, in turn, affected participants' performance. Furthermore, listening comprehension can be conceptualized more broadly to include additional skills such as prior knowledge and verbal reasoning (Scarborough, 2001), which was not done in the current study. Our findings regarding the dimensionality of linguistic comprehension may have differed had we modeled the listening comprehension construct with different types of measures.

Likewise, we recognize that the WJ Passage Comprehension subtest, which was used to measure reading comprehension, has been critiqued as being too heavily influenced by word reading skills (Keenan et al., 2008). This may partially explain the prominence of decoding in the SEMs and quantile regression models. Regrettably, this was the only measure of reading comprehension administered in the larger study. The availability of even one more measure would have allowed us to model a latent construct of reading comprehension and circumvent the drawbacks of any particular measure. We recommend that future studies on the SVR with struggling adult readers should endeavor to include multiple reading comprehension measures and construct a fully latent model.

Our sample was limited to native English speakers. Future studies can examine whether the present findings can be generalized to struggling adult readers who are nonnative English speakers. Particularly, it is possible that nonnative English speakers' reading comprehension performance may be better predicted by a multiplicative iteration of the SVR (Hoover & Gough, 1990).

Even though we analyzed various iterations of the SVR, we recognize that none of our models included indirect contributions to reading comprehension. Evidence from readers in the third grade suggests that the effect of linguistic comprehension on reading comprehension may be mediated by decoding (Tunmer & Chapman, 2012). This indirect effect should be tested in mediation models with struggling adult readers.

Although beyond the scope of this investigation, it would be valuable to explore whether the relations between the SVR components and reading comprehension are moderated by learning disability status. It is difficult to obtain reliable self-reports of learning disability diagnoses among this population. Due to varying educational histories and countries of origin, adults who have learning disabilities may have never been diagnosed. Additionally, many adults may not remember whether they had received a diagnosis as a child. We hope that future studies can utilize clinical assessments to estimate the incidence of learning disabilities for struggling adult readers.

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Table 1
Demographic Information

Characteristic	*n*	%
Country		
United States	222	56.6
Canada	170	43.4
Gender		
Female	241	61.5
Male	144	36.7
Not reported	7	1.8
Age		
16 – 19 years	34	8.7
20 – 29 years	130	33.2
30 – 39 years	64	16.3
40 – 49 years	59	15.1
50 – 59 years	72	18.4
60 – 69 years	27	6.9
70 years or older	3	0.8
Not reported	3	0.8
Race		
Black	274	69.9
White	93	23.7
Native/Indigenous	11	2.8
Other	6	1.6
Not reported	8	2.0

Table 2

Performance on Measures

Measure	Raw Scores			Cronbach's	Mean Grade	Age-Based Standard Scores		
	Mean	SD	Range	Alpha	Equivalent	Mean	SD	Range
WJPC	29.33	4.41	16 - 42	.81	4.0	84.44	8.81	51 - 111
WJLWI	55.00	8.51	33 - 72	.93	5.3	82.61	10.40	42 - 106
TIWRE	37.99	5.07	20 - 48	.89	7.1	87.36	11.72	46 - 110
WJWA	16.49	7.63	1 - 31	.89	3.1	81.27	11.96	32 - 115
WJSR	38.60	12.42	10 - 78	.83		86.04	10.65	51 - 118
WJUD	38.76	7.04	14 - 56	.88		85.34	8.52	49 - 116
CUSP	7.70	3.89	0 - 40	.73				
CWC	23.36	7.47	0 - 43	.82				
CWD	19.07	8.22	0 - 44	.86				
WJPV	26.25	4.14	15 - 39	.83	5.7	83.11	7.21	56 - 107

Note. Grade equivalents and age-based norms were not available for certain measures. Cronbach's alpha estimates are for the current sample. WJPC = WJ Passage Comprehension; WJLWI = WJ Letter-Word Identification; TIWRE = Test of Irregular Word Reading Efficiency; WJWA = WJ Word Attack; WJSR = WJ Story Recall; WJUD = WJ Understanding Directions; CUSP = CELF Understanding Spoken Paragraphs; CWC = CELF Word Classes; CWD = CELF Word Definitions; WJPV = WJ Picture Vocabulary.

Table 3
Correlations

	WJPC	WJLWI	TIWRE	WJWA	WJSR	WJUD	CUSP	CWC	CWD
WJPC	—								
WJLWI	.603***	—							
TIWRE	.602***	.828***	—						
WJWA	.452***	.770***	.704***	—					
WJSR	.420***	.143***	.120*	.117*	—				
WJUD	.564***	.265***	.290***	.300***	.411***	—			
CUSP	.352***	.133*	.122*	.105*	.497***	.423***	—		
CWC	.599***	.405***	.336***	.316***	.408***	.490***	.400***	—	
CWD	.494***	.328***	.261***	.242***	.447***	.401***	.378***	.596***	—
WJPV	.588***	.337***	.368***	.269***	.452***	.447***	.385***	.558***	.613***

Note. *** $p < .001$; * $p < .05$. WJPC = WJ Passage Comprehension; WJLWI = WJ Letter-Word Identification; TIWRE = Test of Irregular Word Reading Efficiency; WJWA = WJ Word Attack; WJSR = WJ Story Recall; WJUD = WJ Understanding Directions; CUSP = CELF Understanding Spoken Paragraphs; CWC = CELF Word Classes; CWD = CELF Word Definitions; WJPV = WJ Picture Vocabulary.

Table 4
Fit Indices for Models

Model Description	$\chi^2(df)$	p	CFI	TLI	RMSEA	SRMR	AIC	BIC
1. CFA for linguistic comprehension	40.7(9)	<.001	.959	.931	.095	.037	5575	5647
2. CFA for oral vocabulary and listening comprehension	15.8(8)	.045	.990	.981	.050	.022	5552	5628
3. CFA for decoding, oral vocabulary, and listening comprehension	59.6(24)	<.001	.978	.967	.062	.040	7860	7980
4. SEM for reading comprehension without interaction	98.0(30)	<.001	.966	.949	.076	.040	8589	8728
5. SEM for reading comprehension with interaction between decoding and oral vocabulary							8591	8734
6. SEM for reading comprehension with interaction between decoding and listening comprehension							8591	8734

Note. χ^2 = Chi square statistic. *df* = degrees of freedom. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index. RMSEA = Root Mean Square Error of Approximation. SRMR = Standardized Root Mean Square Residual. AIC = Akaike Information Criterion. BIC = Bayesian Information Criterion. Model indices other than AIC and BIC are not available for models that include interactions.

Table 5
Quantile Regression Parameter Estimates for Reading Comprehension

Predictor	β	SE	*t*	Unique Pseudo R^2	Total Pseudo R^2
.1 Quantile					.409
Decoding	0.455	0.079	5.75***	.126	
Listening Comprehension	0.261	0.111	2.34*	.032	
Oral Vocabulary	0.481	0.106	4.55***	.065	
.5 Quantile					.365
Decoding	0.366	0.055	6.60***	.066	
Listening Comprehension	0.360	0.078	4.61***	.036	
Oral Vocabulary	0.418	0.074	5.64***	.057	
.9 Quantile					.370
Decoding	0.333	0.072	4.596***	.061	
Listening Comprehension	0.437	0.099	4.437***	.041	
Oral Vocabulary	0.361	0.078	4.643***	.059	

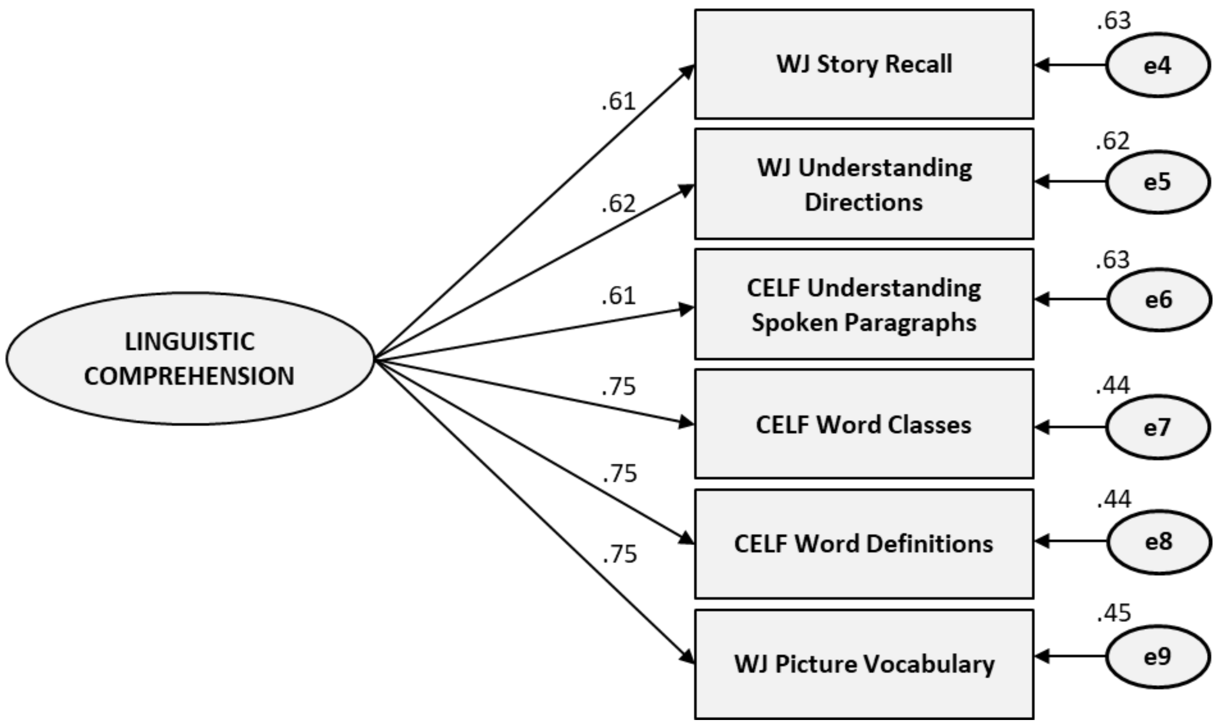

Figure 1. One-factor CFA model for linguistic comprehension. Standardized estimates are reported.

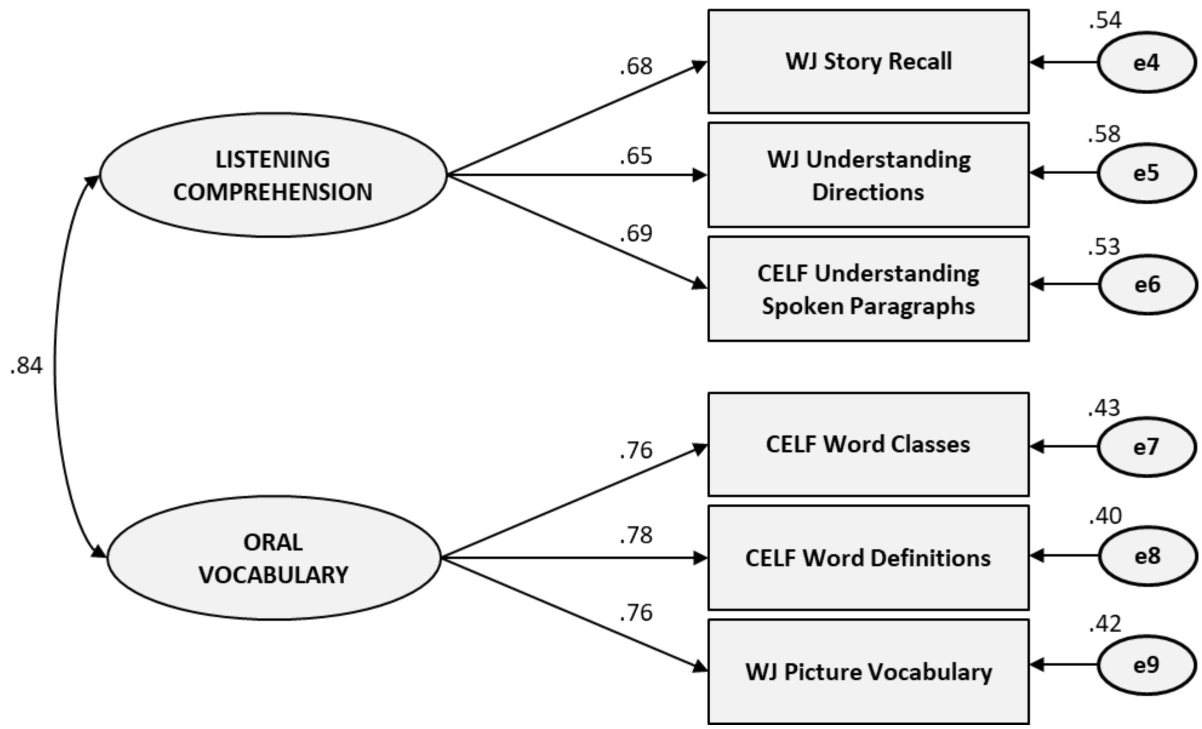

Figure 2. Two-factor CFA model for listening comprehension and oral vocabulary. Standardized estimates are reported.

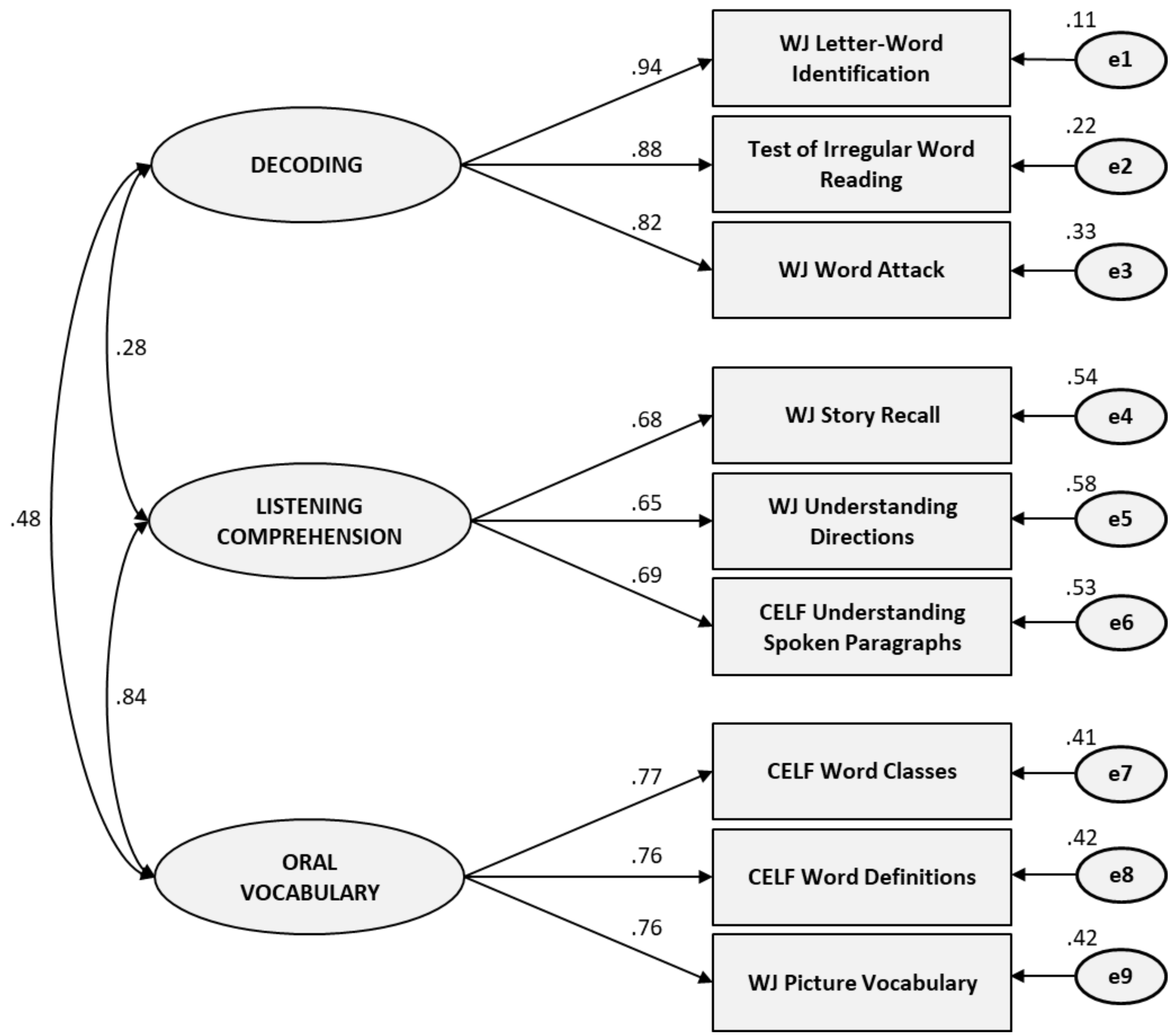

Figure 3. Three-factor CFA model for decoding, listening comprehension, and oral vocabulary. Standardized estimates are reported.

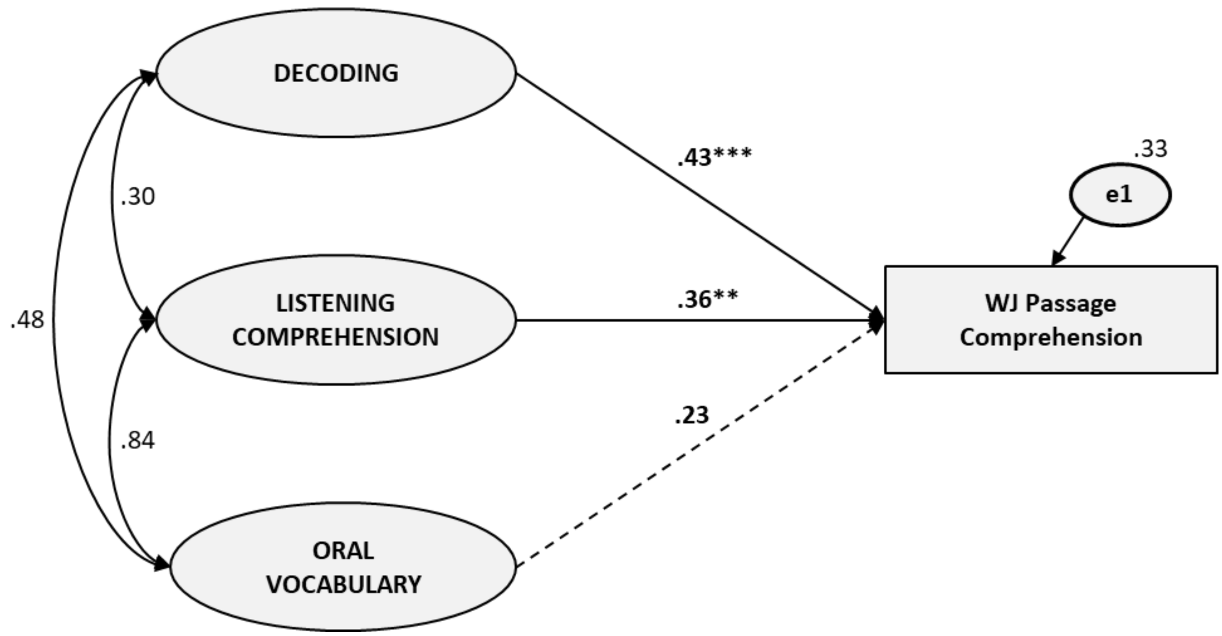

Figure 4. SEM for reading comprehension with decoding, listening comprehension, and oral vocabulary as predictors. Standardized estimates are reported. *** $p < .001$; ** $p < .01$.

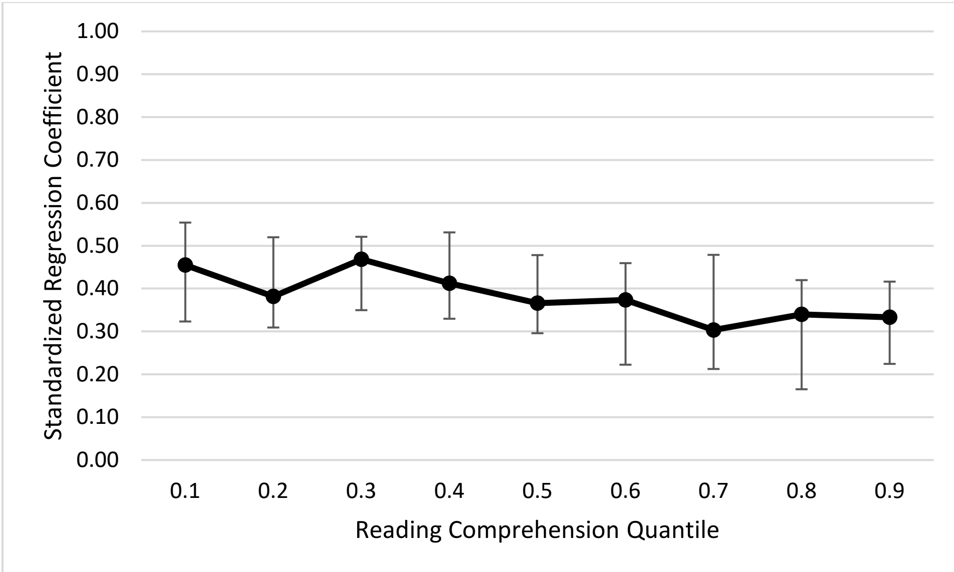

Figure 5. Quantile regression plot for the relation between decoding and reading comprehension after controlling for listening comprehension and oral vocabulary. Error bars indicate 95% confidence intervals.

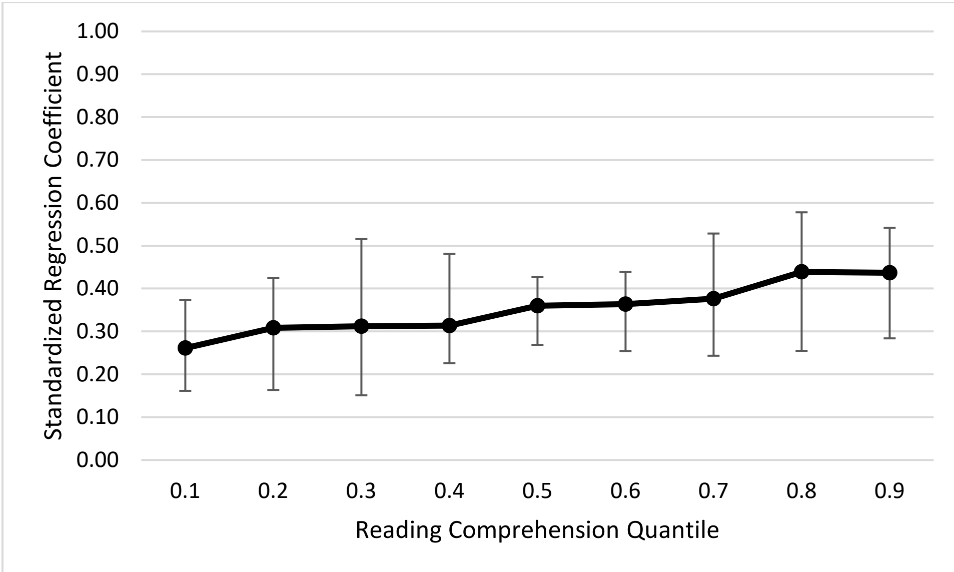

Figure 6. Quantile regression plot for the relation between listening comprehension and reading comprehension after controlling for decoding and oral vocabulary. Error bars indicate 95% confidence intervals.

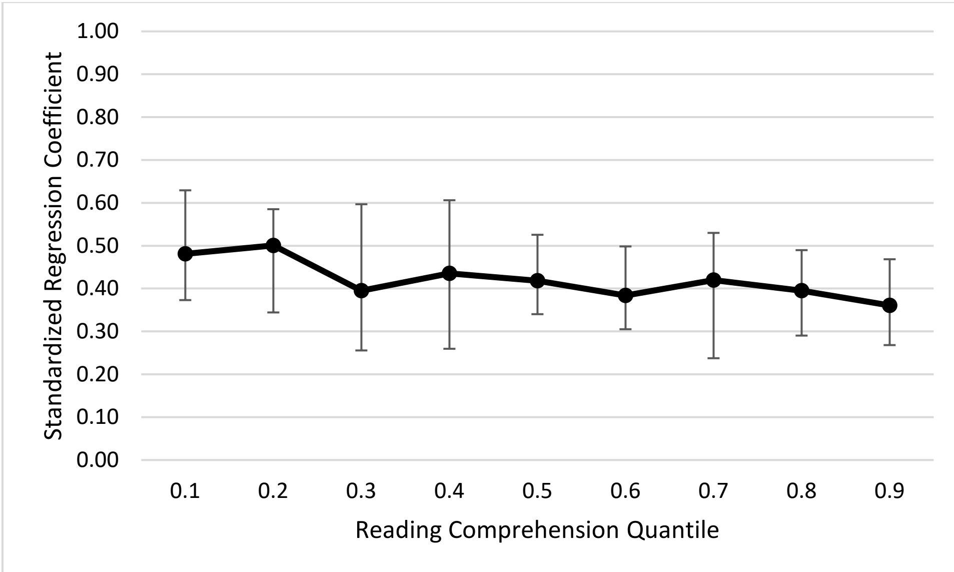

Figure 7. Quantile regression plot for the relation between oral vocabulary and reading comprehension after controlling for decoding and listening comprehension. Error bars indicate 95% confidence intervals.