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Reading comprehension precursors: Evidence of the simple view of reading in a transparent orthography

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The Simple View of Reading (SVR) proposes that reading comprehension depends on two general processes —language comprehension and word recognition— and that the contribution of these known processes to reading comprehension varies in time. Specifically, the contribution of word recognition decreases, and the contribution of language comprehension increases with student progress. The purpose of this study was to test the SVR in a large sample of 4,750 Dominican public-school students from second (n = 2,399) and fourth grade (2,351) and determine the contribution of phonological awareness within the SVR. The study found that word recognition and language comprehension explained 80% of the variance in reading comprehension regardless of grade. A quantile regression showed that, as reading comprehension progresses, language comprehension's predictive power increases, and word recognition's predictive power decreases. A structural equation model conducted on each grade separately showed that the contribution of word recognition toward reading comprehension remained stable between second and fourth grade. This means that, although the dynamism of the SVR components follows the same pattern reported in the literature, the students evaluated here might reach reading automaticity later than expected. Therefore, more attentional resources need to be allocated toward decoding. The study found that the contribution of phonological awareness toward word recognition increases from second to fourth grade, confirming that students are taking longer than expected to obtain reading automaticity and still going through an overt effortful decoding stage rather than a covert phonological recoding stage, making reading more effortful.

Introduction

The Simple View of Reading (SVR) model proposes that reading comprehension –the ability to extract meaning from text– depends on two main processes: word recognition and language comprehension (Hoover and Gough, 1990). Although the theory was not written to inform educational reading interventions, it has been shown to help understand the factors that contribute to reading comprehension both at the individual reader level and the classroom level (Savage et al., 2015). The theory has been tested in both opaque and transparent orthographies (Kim and Pallante, 2012; Kendeou et al., 2013; Torppa et al., 2016), in monolingual and multilingual contexts (Verhoeven and van Leeuwe, 2012), including late bilinguals (Sparks and Patton, 2016), and for typical and struggling readers (Georgiou et al., 2009; Gustafson et al., 2013). Most studies have used cross-sectional designs, although some have used this framework to describe the relationship between the SVR components longitudinally (Kim and Pallante, 2012; Torppa et al., 2016; Hjetland et al., 2019).

Some authors have criticized the model since it could mislead practitioners to believe that word recognition and language comprehension are mutually exclusive and could leave out additional variables that predict reading comprehension (Catts, 2018; Duke and Cartwright, 2021). In addition, researchers operationalize and measure word recognition and language comprehension in many ways, creating ambiguity in the literature. Other authors propose moderating and mediating variables between word recognition and language comprehension that should be considered to explain reading comprehension (Duke and Cartwright, 2021) since the relationship between language comprehension and word recognition is not entirely independent (Tunmer and Chapman, 2012). Notwithstanding this criticism, studies show that this overall model to explain reading comprehension continues to be a good fit.

The language comprehension SVR component refers to interpreting oral discourse (Hoover and Gough, 1990). Language comprehension is measured under the SVR framework by vocabulary tests, verbal cognitive ability tests, morphosyntactic ability, and listening comprehension (Ripoll Salceda et al., 2014).

The word recognition SVR component refers to recognizing words fast and effortlessly. The process of obtaining such a level of automaticity can be explained by the dual-route model of word recognition (Coltheart and Rastle, 1994). This model asserts that reading words engages two routes: a phonological route that taps into pure decoding abilities in which graphemes are serially mapped into phonemes to decode a word. Lastly, a lexical route allows the individual to recognize a well-known word automatically as a whole. Using one route or the other depends on word frequency, reading experience, and orthographic transparency. When word recognition becomes automatic, more attentional resources are available for reading comprehension (LaBerge and Samuels, 1974; Samuels, 2004). Under the SVR framework, word recognition is measured by obtaining accuracy scores in word reading, non-word reading, and text reading, in addition to speed and efficiency (Ripoll Salceda et al., 2014).

An important precursor of word recognition is phonological awareness, which consists of having conscious awareness of the sound structure of a language (Anthony and Francis, 2005). Multiple studies suggest that, in the initial stages of learning to read, a certain degree of phonological awareness is required to start mapping sounds to letters by engaging the phonological route (Schatschneider et al., 2004; Hogan et al., 2005). The development of phonological awareness is similar across languages, but its timing depends on the spoken language's syllabic structure and its orthographic transparency (Goswami, 2008). This means that individuals who speak a language of simple syllabic structure and shallow orthographies would develop phonological awareness skills faster than those who speak languages of more complex syllabic structure and deeper orthographies. A meta-analysis on reading and phonological awareness in Spanish speakers found a moderate correlation between phonological awareness (especially syllabic and intra-syllabic awareness) and several reading measurements, that is, word and pseudoword reading and reading comprehension (Míguez-Álvarez et al., 2022). There is evidence that phonology plays an important role in word recognition for novice and skilled readers. Although behavioral studies show decreasing reliance on phonological processes as reading skills improve, the decrease does not imply that phonological awareness is not important for word recognition but that during learning to read, the nature of the relationship changes (Milledge and Blythe, 2019). In this sense, in learning to read, the reader transitions from an overt decoding process to a covert phonological recoding process. That is, from effortful and serial letter sounding for word recognition, to effortless pre-lexical access to a printed word's sound.

The contribution of the SVR components is dynamic across time and reading proficiency. This means that the weights of language comprehension and word recognition vary. Catts (2018) and Lonigan et al. (2018) showed that when children are learning to read, there is a heavy load on the word recognition component, given that, at this stage, decoding is necessary to access the written content. If decoding has not been mastered, there is no access to the content, so comprehension cannot occur. When decoding abilities have reached higher levels and words are read partially automatically, the load in language comprehension increases.

The SRV components' contribution timing depends on orthographic transparency (Catts, 2018). Students learn to decode faster when learning to read in transparent orthographies (Florit and Cain, 2011; Joshi, 2018). This means that, although relevant, the contribution of word

recognition to reading comprehension tends to be short-lived in transparent orthographies, such as Finnish (Torppa et al., 2016) and Italian (Tobia and Bonifacci, 2015), and early in the process, language comprehension acquires a critical weight. A similar result was found in vowelized (transparent) vs. non-vowelized (opaque) versions of Arabic, in which the contribution of word recognition toward reading comprehension increased with age for the opaque version of Arabic but decreased for the transparent version of Arabic (Asadi and Ibrahim, 2018).

Spanish has a relatively transparent orthography (Bravo-Valdivieso and Escobar, 2014). A study that explored reading acquisition in Spanish-speaking Chilean children found that, in the initial stages of learning to read, both language comprehension (as measured by vocabulary) and word recognition predict reading comprehension in kindergarten and first grade, and that code-related skills (such as non-word reading) strongly contribute to reading comprehension in first grade, validating the SVR for this particular language and orthography (Kim and Pallante, 2012). A study that explored the SVR on Spanish-speaking Ecuadorian fourth-graders found that word recognition and language comprehension predicted distinct aspects of reading comprehension, but that word recognition speed and accuracy were separate constructs and contributed differently toward reading comprehension (Ripoll Salceda et al., 2017). Another study on Spanish 7- to 12-year-olds with language impairments found that language comprehension predicted reading comprehension when word recognition was held constant, validating the SVR (Mesa Melgarejo et al., 2013). Although these studies provide evidence of the usefulness of SVR in understanding Spanish reading abilities, more research is needed to understand the dynamics of the SRV components in different contexts as a theoretical framework and an intervention strategy.

Context of the present study

The Dominican Republic has faced numerous educational challenges throughout the years. One of the main concerns is students' reading comprehension scores reported by national (MINERD, 2017, 2018) and international evaluations (UNESCO, 2015, 2021). The analysis for the Dominican Republic on the Third Regional Comparative and Explanatory Study (UNESCO, 2016) reports that the following variables predict reading comprehension: (1) For third graders, availability of a school workbook, attendance, and timeliness of teachers, being a girl, and family socioeconomic position positively predict reading comprehension; while the repetition of a school grade negatively predicts reading comprehension. (2) For sixth graders, (UNESCO, 2016) the use of computers outside of the school, availability of books, availability of workbooks, attendance and timeliness of teachers, family socioeconomic position, study time at home, and parental

expectations positively predicted reading comprehension; while the use of computers in school and repetition of a school-grade negatively predicted reading comprehension.

Project USAID-Read is a 7-year intervention aimed at improving literacy skills in Dominican public-school primary students, funded by the United States Agency for International Development (USAID) and implemented by the Universidad Iberoamericana (UNIBE). The project focused on teacher training, teacher coaching, and developing and implementing reading practice materials to drive reading automaticity. A total of 387 public schools are part of the project, and as of 2022, more than 200,000 students had received the intervention. The project used the SVR as a framework to design the intervention. It, therefore, measured the corresponding SVR components in a baseline and a midline evaluation with a control group as a counterfactual (Sánchez-Vincitore et al., 2020). Baseline was conducted in 2015 when students were in second grade, while midline was conducted in 2017 when they were in fourth grade. The study found no statistically significant differences at baseline between the groups in all evaluated measures (short-term phonological memory, phonological awareness, letter knowledge, oral language comprehension, words and pseudowords correct per minute, fluency, and reading comprehension). After 2 years of intervention, the midline evaluation showed that project USAID-Read students significantly outperformed students from the control group in reading comprehension precursors (phonological short-term memory, phonological awareness, letter knowledge, oral language comprehension, and words and pseudowords correct per minute), but not in text fluency and reading comprehension. The authors explained that the lack of differences between groups could be explained by the fact that the intervention was in a developing stage during the midline evaluation and that the practice reading materials to support reading automaticity had not been distributed.

Given that project, USAID-Read generated data under the SVR framework and the scarcity of SVR research in Spanish, the purpose of the present correlational study was to evaluate the SVR within the Dominican context, conducting secondary data analysis on the studies generated by project USAID-Read in large samples of second and fourth grade (regardless of belonging to a control or experimental group) to answer the following research questions:

1. What are the explicative weights of word recognition and language comprehension across reading comprehension proficiency?

We hypothesized that word recognition would contribute more than language comprehension at lower levels of reading comprehension proficiency. Also, language comprehension would contribute more than word recognition at higher levels of reading comprehension proficiency.

1. What is the contribution of phonological awareness to word recognition within the SVR framework in second and fourth grades?

We hypothesized that phonological awareness would contribute more to word recognition in the second-grade sample and less in the fourth-grade sample, given that it is expected that older children engage more in the lexical route than the phonological route in late primary grades as reading automaticity should have been attained. In other words, we expect a more covert phonological process in later grades than in earlier grades.

Materials and methods

The methodology for this study has been described in another paper (Sánchez-Vincitore et al., 2020). These data correspond to an impact evaluation of the effectiveness of the project USAID-Read intervention. The original study had an experimental design, where 400 public schools were randomly assigned to either a control group (200 schools) or an experimental group (200 schools). Schools from the experimental group received project USAID-Read intervention (teacher training, teacher coaching, and materials to practice reading), while schools from the control group continued to follow the standard programing designed by the Ministry of Education. A stratified cluster sampling scheme was used to select the sample. The stratification guaranteed that Dominican educational regions were represented. At the same time, a two-stage cluster sampling was used to determine the number of students to be selected for each school to obtain a probabilistic sample (Mencía-Ripley et al., 2016; Sánchez-Vincitore et al., 2020). The present study follows a cohort design, which means that students from midline were different from students at baseline. Still, they belonged to the same control or experimental schools and were randomly selected. For the present correlational study, no group comparisons were conducted.

Participants

A total of 4,750 public-school students participated in the study (2,399 second graders evaluated in 2015 and 2,351 fourth graders assessed in 2017). There were 2,407 girls (1,187 in second grade and 1,220 in fourth grade), and 2,331 boys (1,200 in second grade and 1,131 in fourth grade). A total of 549 (22.9% of second-graders and 11% of fourth-graders) were identified as having some degree of disability, as reported by their teachers. Disability categories were psychological, neurological, physiological, or learning-related. This study was revised and approved by Universidad Iberoamericana's Ethics Committee.

Instruments

United States Agency for International Development – Read reading battery

Listening comprehension: This measurement was created by project USAID-Read, following recommended guidelines (USAID, 2016). In this assessment, the evaluator read three short stories to the participants, and they had to respond to five open literal comprehension questions after listening to each story. The stories were short (60–63 words) and culturally relevant. Participants scored 0 for incorrect and 1 for correct answers. The total score for each story corresponds to the percentage of correct responses (from 0 to 1) within the story. The total score for oral comprehension corresponds to the mean of the scores from the three stories (from 0 to 1). Cronbach's alpha for this instrument in this study was 0.71.

Phonological awareness 1

On this measurement, participants were asked to identify the initial sound of a word. There was a total of 10 items. The score for this measurement corresponds to the percentage of correct responses (from 0 to 1). Cronbach's alpha for this instrument in this study was 0.93.

Phonological awareness 2

On this measurement, participants were asked to identify which two words –presented on a series of three words– had similar initial sounds. There was a total of 10 items. The score for this measurement corresponds to the percentage of correct responses (from 0 to 1) The Cronbach's alpha for this instrument in this study were 0.69 and 0.60.

Words and pseudowords per minute

These instruments assess the speed at which students transform graphemes to phonemes in isolated pseudowords and words. We chose this speed measurement since it is a better predictor of reading comprehension as part of the word recognition component of the SVR (Florit and Cain, 2011). It has two subtests: pseudowords per minute and words per minute. The pseudowords-per-minute task gives participants a list of made-up words to be read aloud to the evaluator. The pseudowords were created using Wuggy (Keuleers and Brysbaert, 2010), an electronic pseudoword generator for multiple languages. The words-per-minute task presented participants with a list of words to be read aloud to the evaluator. The score for this measurement counts the correct items that participants read in one minute. The Cronbach's alpha for this instrument in this study were 0.98 and 0.99.

Fluency

This instrument measures the speed at which students read words in connected text. Students were presented with three culturally relevant short stories of around 63 words. It was a

parallel form of the oral comprehension assessment. The score for each story corresponds to the count of correct words per minute. In the case of students who read the 63 words faster, the scores were prorated. The total score for reading fluency was calculated by averaging the scores of the three stories. Since these stories were also used for reading comprehension measures, the evaluators would calculate words per minute. However, participants were allowed to finish the stories to answer reading comprehension questions. The Cronbach's alpha for this instrument in this study was 0.98.

Reading comprehension: This measurement consists of five literal comprehension questions read by the evaluator to the students after each story from the Fluency measurement. Participants received a score of 0 for incorrect and 1 for correct responses. The total score for each story corresponds to the percentage of correct answers (from 0 to1) within the story. The total score for reading comprehension corresponds to the percentage of correct responses from all the stories (from 0 to 1). The Cronbach's alpha for this instrument in this study was 0.96.

Sociodemographic questionnaire

This instrument obtained general demographic data of each participant, including age, sex, presence of disability (reported by the teacher), and the number of books at home (reported by the student).

Data analysis plan

Before answering the research questions, we present a general overview of the variables by using Pearson's correlation.

We conducted a quantile regression analysis to answer the first research question about the contributing weights of word recognition and oral language comprehension across reading comprehension proficiency. This is a regression technique that estimates the value of the model parameters (beta coefficients of the independent variables) in different quantiles of the dependent variable (Koenker and Basset, 1978). In this case, it allowed us to estimate the contribution of word recognition and language comprehension to reading comprehension as proficiency increases, regardless of the participant's grade. For this analysis, word recognition was captured by the fluency measurement, and the average of listening comprehension instruments captured language comprehension.

The second research question explored the contribution of phonological awareness to word recognition within the SVR model in second and fourth grades. To determine this contribution, we conducted a structural equation model (SEM) on each sample (second and fourth grades). The model contained the following latent factors: word recognition, language comprehension, reading comprehension, and phonological awareness. For word recognition, the indicators were words per minute and pseudowords per minute. For language comprehension, the indicators were

accuracy scores of the three listening comprehension tasks. For reading comprehension, the indicators were the accuracy scores of the three reading comprehension tasks. Finally, for phonological awareness, the indicators were the accuracy scores of the two phonological awareness tasks.

We used a Maximum Likelihood robust estimator (Finney and DiStefano, 2006) with Full Information Maximum Likelihood (FIML) method to address missing data and mild violations of normality assumptions (Enders and Bandalos, 2001). We used the two typical SEM sub-models: the measurement and structural models. Measurement errors of observed variables were allowed to vary. The structural model specifies the hypothetical directed relations among the latent variables for each theoretical model. Using multiple measures takes measurement error into account, thereby resulting in a better assessment of each latent variable. To evaluate model fit, we examined a range of fit indices (Lomax, 2013). We evaluated fit based on the following indices: ratio χ^2/degrees of freedom, for which values <3 was considered acceptable (Schermelleh-Engel et al., 2003), the root mean square error of approximation (RMSEA), for which values of <0.08 indicate acceptable fit (MacCallum and Austin, 2000); the standardized root mean square residual (SRMR), for which values of <0.05 indicate good fit (Kline, 2016); the comparative fit index (CFI) and the Tucker-Lewis index (TLI), for which values of >0.90 indicate good fit (Kline, 2016). We did not estimate the residual covariances because the model did not consider that indicators will correlate more than is explained by the relation between the latent factors.

We used Microsoft Excel, R tool, IBM SPSS Statistics 25, and JASP 0.16 for data cleaning and analysis.

Results

We conducted a Pearson's correlation analysis to determine the relationship between the variables. Since reading-related variables are dynamic across time, separate analyses were performed independently for second and fourth grades.

As seen in Tables 1 and 2, the correlation strength between reading comprehension and variables that capture word recognition (fluency, words per minute, and pseudowords per minute) tends to decrease between second and fourth grade, although the correlations remain very strong (>0.50, based on criteria Cohen, 1988): from $r = 0.911$ to $r = 0.807$ in fluency; from $r = 0.901$ to $r = 0.725$ in words per minute; and from $r = 0.877$ to $r = 0.678$ in pseudowords per minute. The relationship between reading comprehension and listening comprehension tends to increase from second to fourth grade (from $r = 0.303$ to $r = 0.387$). We confirmed that these were different after conducting a z-test of two-tailed hypotheses to compare the two correlations ($p = 0.001$).

Research question 1: What are the explicative weights of word recognition and language comprehension across reading proficiency?

To confirm the validity of the SVR, we conducted a linear regression that predicts reading comprehension with a merged sample of second and fourth grades. The independent variables were word recognition (as measured by fluency) and language comprehension (as measured by listening comprehension). We obtained a model with adjusted $R^2 = 0.805$ [$F(2,4745) = 9788.025$; $p < 0.001$].

We conducted a quantile regression analysis to evaluate the evolution of the predictive role of word recognition and language comprehension as reading comprehension skill increases regardless of grade. See **Figure 1** for a graphical representation.

Figure 1 shows that the contribution of word recognition increases as reading comprehension scores increase. The contribution of word recognition starts to decrease at the 70th percentile of the variable reading comprehension. This corresponds to a direct accuracy score of 73%. On the other hand, language comprehension's contribution to reading comprehension remains low for the first 65 percentiles, which corresponds to a direct accuracy score of 67%. The contribution starts to increase steadily.

Research question 2: What is the contribution of phonological awareness to word recognition within the SVR framework?

For the SEM, we first conducted a confirmatory factor analysis to ensure that the indicators were a good fit for the latent factors. For both grades, the analysis showed an acceptable fit to the data: χ^2 (29) = 53.45, $p < 0.01$, RMSEA = 0.03, CFI = 1, TLI = 1, SRMR = 0.01 in second grade; and χ^2 (29) = 101.04, $p < 0.001$, RMSEA = 0.04, CFI = 0.99, TLI = 0.99, SRMR = 0.02 in fourth grade. Factor loadings remained higher than 0.5. See **Figure 2** for a graphical representation of the analysis.

The SEM studied, on one hand, the effect of phonological awareness on word recognition and, on the other hand, the effect of the predictor factors word recognition and language comprehension on the outcome factor reading comprehension. A model was designed with the factors mentioned for both grades (**Figures 3**, **4**), obtaining, in both cases, acceptable levels of goodness-of-fit: χ^2 (31) = 83.71, $p < 0.001$, RMSEA = 0.03, CFI = 1.00, TLI = 1.00, SRMR = 0.02 for the second grade model and χ^2 (31) = 128.27, $p < 0.001$, RMSEA = 0.04, CFI = 0.99, TLI = 0.99, SRMR = 0.02 for the fourth grade. See **Figures 3**, **4** for the models' graphic representation.

The results show a significant influence of phonological awareness on word recognition in both samples. However, the regression coefficients increased from second grade (0.55) to fourth grade (0.61). Regression coefficients show that word recognition maintains its impact on reading comprehension from second to fourth-grade samples (0.72 and 0.70, respectively). On the other hand, the contribution of

TABLE 1 Pearson's correlation indices, second grade.

	PA1	PA2	LC	WPM	PWPM	F
PA2	0.329**					
LC	0.347**	0.275**				
WPM	0.363**	0.308**	0.248**			
PWPM	0.352**	0.314**	0.246**	0.954**		
F	0.362**	0.310**	0.246**	0.932**	0.909**	
RC	0.398**	0.342**	0.303**	0.901**	0.887**	0.911**

*Significant correlation $p < 0.05$, **Significant correlation $p < 0.01$.
PA1, Phonological awareness 1; PA2, Phonological awareness 2; LC, Language comprehension; WPM, Words per minute (correct); PWPM, Pseudowords per minute (correct); F, Fluency; RC, Reading comprehension.

TABLE 2 Pearson's correlation indices, fourth grade.

	PA1	PA2	LC	WPM	PWPM	F
PA2	0.400**					
LC	0.350**	0.357**				
WPM	0.383**	0.407**	0.254**			
PWPM	0.350**	0.377**	0.241**	0.861**		
F	0.377**	0.396**	0.244**	0.889**	0.826**	
RC	0.403**	0.409**	0.387**	0.725**	0.678**	0.807**

*Significant correlation $p < 0.05$, **Significant correlation $p < 0.01$.
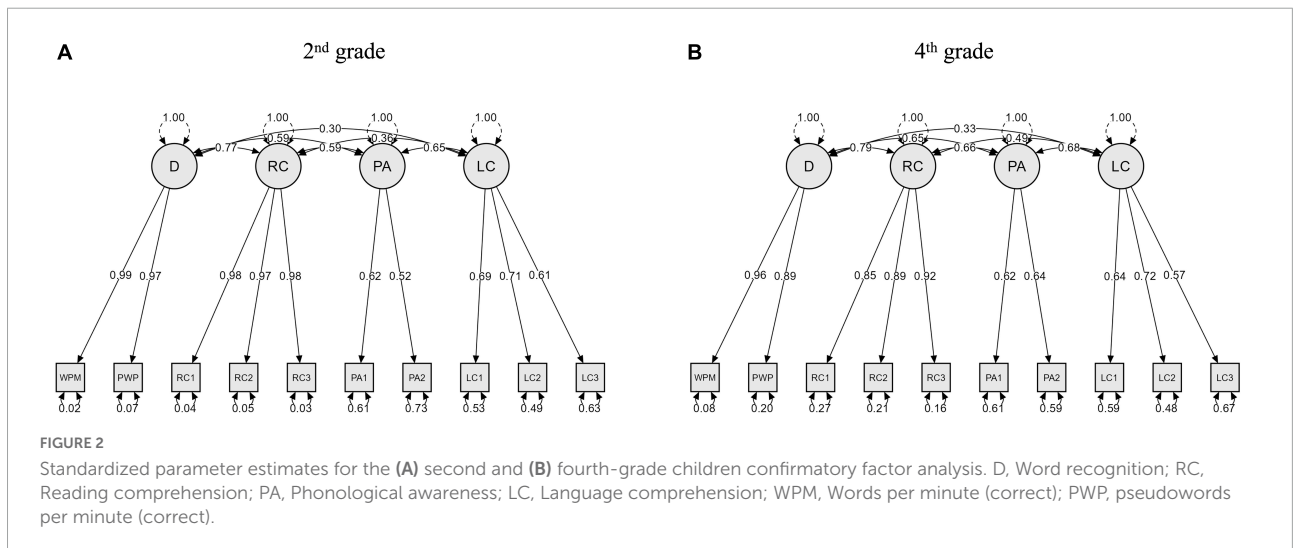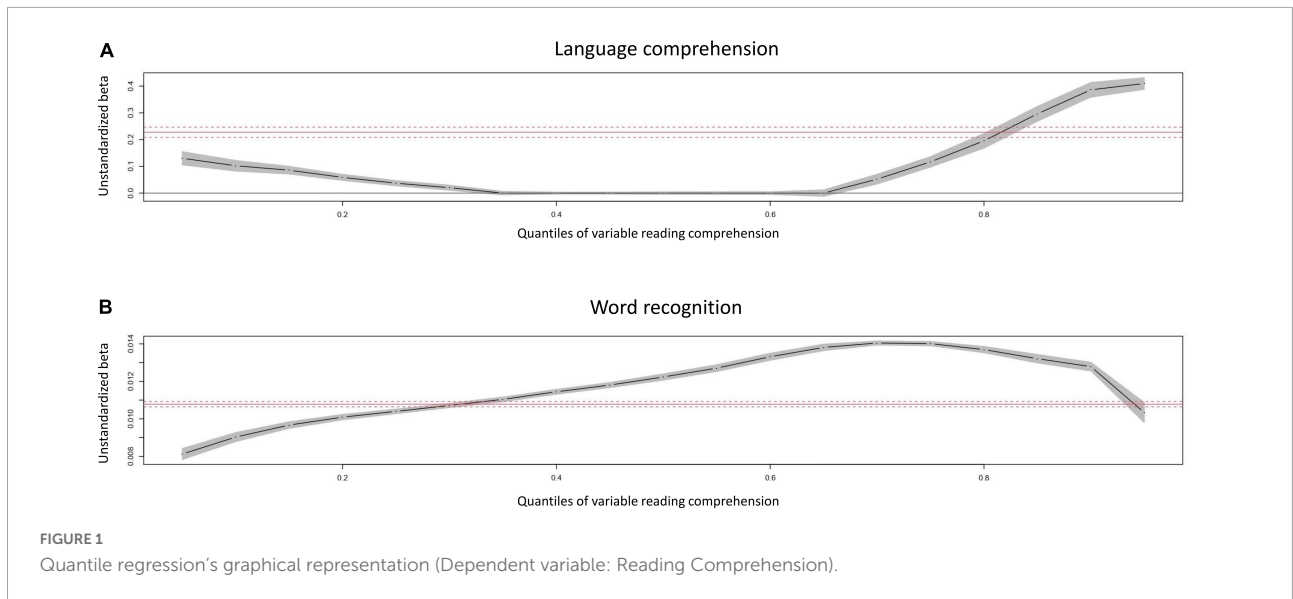PA1, Phonological awareness 1; PA2, Phonological awareness 2; LC, Language comprehension; WPM, Words per minute (correct); PWPM, Pseudowords per minute (correct); F, Fluency; RC, Reading comprehension.

FIGURE 1

Quantile regression's graphical representation (Dependent variable: Reading Comprehension).

FIGURE 2

Standardized parameter estimates for the **(A)** second and **(B)** fourth-grade children confirmatory factor analysis. D, Word recognition; RC, Reading comprehension; PA, Phonological awareness; LC, Language comprehension; WPM, Words per minute (correct); PWP, pseudowords per minute (correct).

oral language comprehension increases across samples (0.16 in second grade to 0.26 in fourth grade).
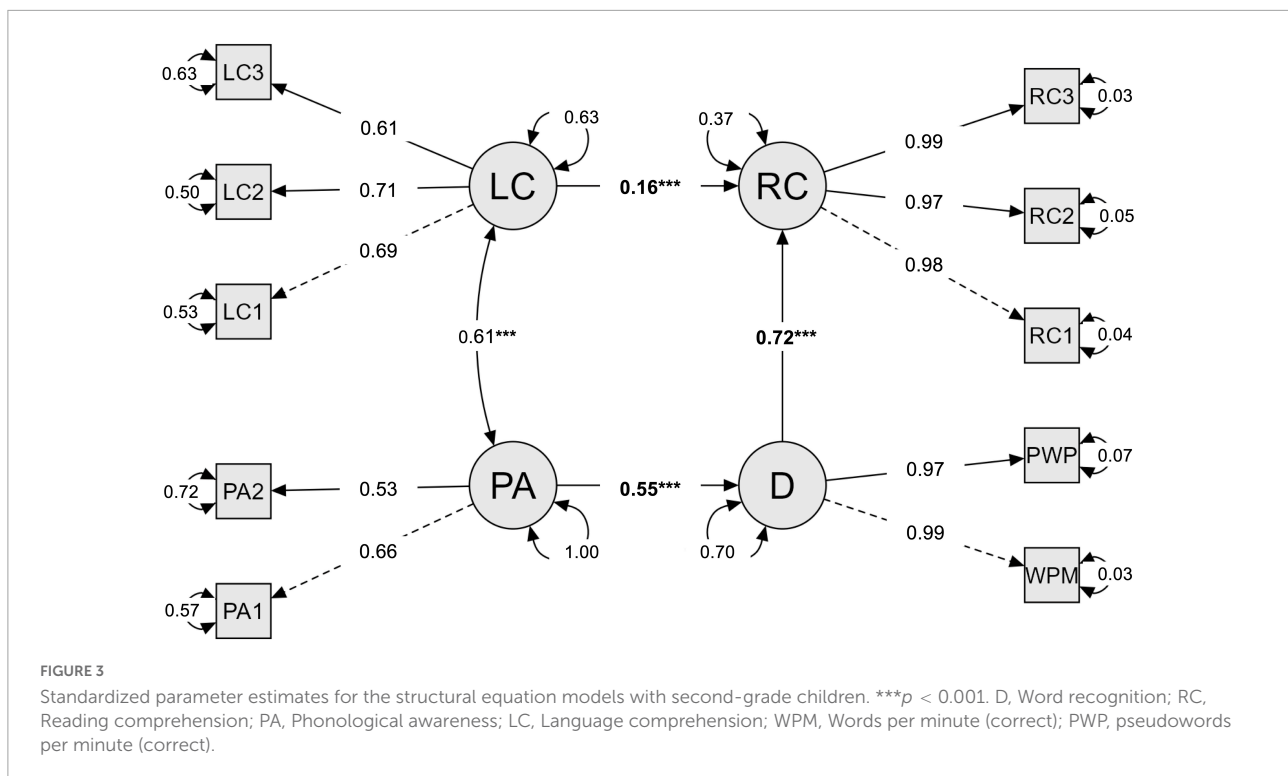
Additional findings

Since sociodemographic information was available, we ran additional analyses unrelated to the research questions. Linear regression was conducted in each grade to study the impact of the presence of disability, sex, and the number of books at home on reading comprehension, obtaining good fitting models [$F(3,2306) = 73.832$ $p < 0.001$ and in second grade and $F(3,2303) = 217.426$; $p < 0.001$ in fourth grade]. Independent variables explained 8.6% of reading comprehension variance in second grade and 22% in fourth grade. See **Table 3** for additional statistical information.

Discussion

The first purpose of this study was to evaluate the SVR in a Dominican sample to test the explicative weights of word recognition and language comprehension to reading comprehension. The study found that word recognition and language comprehension explain 80% of the reading comprehension variance. This confirms that SVR is a valid model for understanding reading comprehension in Dominican students, as seen in other contexts (Kim and Pallante, 2012; Verhoeven and van Leeuwe, 2012; Kendeou et al., 2013; Savage et al., 2015; Torppa et al., 2016).

The quantile regression analysis showed the dynamic nature of the contribution of language comprehension and word recognition to reading comprehension. The findings showed that word recognition predicted reading comprehension during

FIGURE 3
Standardized parameter estimates for the structural equation models with second-grade children. ***p < 0.001. D, Word recognition; RC, Reading comprehension; PA, Phonological awareness; LC, Language comprehension; WPM, Words per minute (correct); PWP, pseudowords per minute (correct).

the initial stages of learning to read, but when it reaches a proficiency threshold, its predicting ability starts to decrease. Conversely, when word recognition has been sufficiently mastered, language comprehension starts predicting reading comprehension. This finding aligns with the literature (Catts, 2018; Lonigan et al., 2018).

However, the decreasing contribution of word recognition was only partially confirmed by the standardized betas from the SEM models. Betas for language comprehension increased from second to fourth grade, indicating that language comprehension's contribution increases as children move into higher school grades. However, the contribution of word recognition remained stable from second to fourth grade. This result contradicts Field Torppa et al. (2016), which found that in transparent orthographies, the predictive contribution of word recognition decreases early during the learning-to-read process since the skill is acquired fast. This result can be explained by the fact that there is considerable overlap between the performance of second and fourth graders in this sample, which means that school-grade might not differentiate reading ability in this particular context.

Furthermore, fourth graders had not reached reading automaticity, as evidenced by their poor performance in Word Recognition (around 40 words per minute). Therefore, it appears that Dominican children are taking longer to master word recognition than children from other countries with languages that have transparent orthographies. Thus the contribution of word recognition remains stable.

The second purpose of this study was to evaluate the contribution of phonological awareness to word recognition within the SVR framework. The SEM found that phonological awareness was a precursor variable of second and fourth graders' word recognition scores and that its contribution increased in fourth grade. The substantial contribution of phonological awareness in fourth grade contradicts the literature. Usually, typically developing children's dependence on phonological awareness for word reading decreases by fourth grade, as shown by behavioral studies (Hogan et al., 2005), but see the literature on eye-tracking techniques reporting the continuous use of phonology in skilled word reading (Milledge and Blythe, 2019). This result is also explained by the fact that children in the fourth-grade group had not yet mastered reading automaticity, as evidenced by low word recognition levels. Low word recognition levels mean more dependence on the phonological route and, therefore, phonological awareness. In other words, fourth-graders evaluated here are still in the overt decoding stage, which is effortful, and have not yet moved to the covert phonological recoding stage.

Although the SVR is an excellent framework, it does not account for all the variance in the reading comprehension (Ripoll Salceda et al., 2014). Therefore, we conducted additional analyses to explore the contribution of other sociodemographic variables obtained during data collection toward reading comprehension. We found an increasing effect of sex, disability, and the number of books at home. These findings are in line with the literature that reports that girls outperform boys
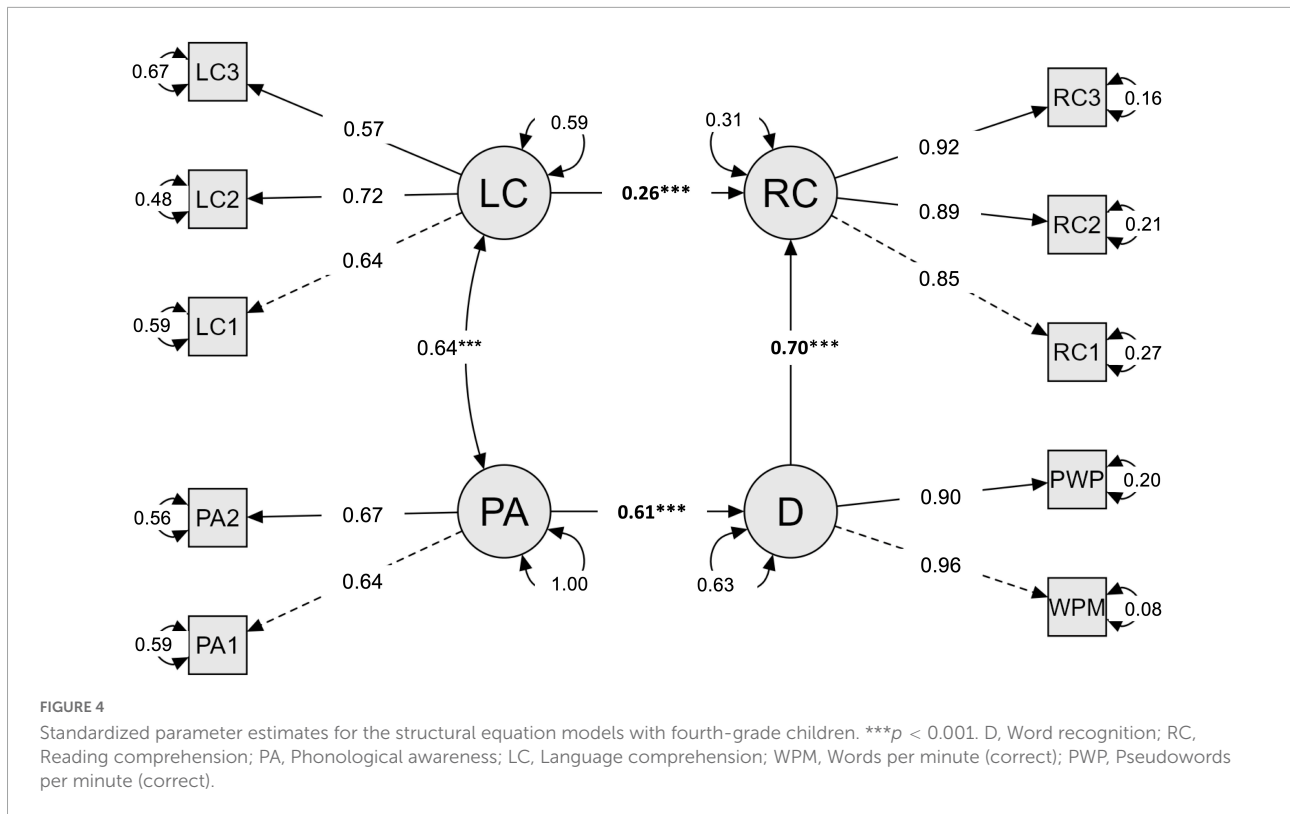
FIGURE 4
Standardized parameter estimates for the structural equation models with fourth-grade children. ***$p < 0.001$. D, Word recognition; RC, Reading comprehension; PA, Phonological awareness; LC, Language comprehension; WPM, Words per minute (correct); PWP, Pseudowords per minute (correct).

TABLE 3 Reading Comprehension by the presence of disability, sex, and number of books at home.

Variable	Second grade			Fourth grade		
	β	t	Significance	β	t	Significance
Disability	−0.255	−12.753	<0.001	−0.418	−22.613	<0.001
Sex	−0.109	−5.451	<0.001	−0.150	−8.098	<0.001
Number of books	0.059	2.981	<0.01	0.086	4.655	<0.001

in reading variables (UNESCO, 2016) and that the children who have learning disabilities are at risk for problems in reading comprehension (Gersten et al., 2001); and that the availability of books at home impacts reading development (Dong et al., 2020).

This study has some limitations that should be considered. The first limitation is related to studies conducted during a period of rapid change in childhood development, and the predictive contribution of the variables changes over time. This was compensated by using the quantile regression and the SEM model disaggregated by grade, but it should be a cautionary note before interpreting the results of this study. Longitudinal studies exploring the timing of each variable's contribution to reading comprehension and its precursors are necessary.

The second limitation has to do with the specific characteristics of this sample. Students in both second and fourth grades had low performance in most variables. Even though Spanish is considered a fairly transparent orthography and the alphabetic principle is acquired relatively fast in

transparent orthographies (Ziegler and Goswami, 2005), the students assessed in this study do not seem to have mastered this skill even in fourth grade, as evidenced by their low accuracy scores in word recognition. This means that orthographic depth (Florit and Cain, 2011), in this case, might not be the only influence of the dynamic patterns of language comprehension and word recognition weights on reading comprehension. Further studies on Dominican Spanish graphic-phonemic mapping and syllabic structure should be conducted to better understand Spanish orthography and its relation to Dominican dialect variation.

The third limitation is that the USAID-Read project serves children from low-income families, so this variable was not considered. Low income is among the strongest predictors of low educational achievement (Broer et al., 2019). In this sense, studies that include a representative sample of Dominican students should be conducted.

The fourth limitation is related to the phonological awareness measurements. The analysis using phonological

awareness variables should be interpreted cautiously, given its acceptable but low internal consistency scores.

The language comprehension component of the SVR needs to be further explored in this population, especially given the poor performance on this variable. Even though word recognition contributed more to reading comprehension than language comprehension in both grades, this is a temporary contribution. As word recognition skills improve and reach ceiling levels, reading comprehension will depend more on language comprehension. If language comprehension remains low, more sophisticated reading comprehension skills might not develop, especially those related to background knowledge and vocabulary. Background knowledge is crucial for inferential and critical comprehension, abilities frequently tested in international evaluations. Exploring language as an end-product when children start primary school might be too late to create appropriate interventions. More studies should be conducted to investigate which and how language comprehension sub-skills contribute to each component of the SVR to propose timely intervention in skills that tend to be stable throughout development and, therefore, only modifiable in early childhood. This is especially important in low-achieving contexts, such as the Dominican Republic's public school system. Longitudinal studies must be taken into consideration to evaluate language development, as international reports emphasize that reading models understudy the language comprehension component of the SVR (Cervetti et al., 2020).

Considering the aforementioned performance of Dominican children in international standardized testing measures and the findings of this project, SVR studies with locally developed instruments that are culturally accessible to children is a valuable tool to study early grade reading. Further studies should also look at developmental aspects of language and how the use of formal Spanish in educational settings, which is quite different from colloquial Spanish, may impact literacy.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions. These data belong to a project funded by USAID. We are not authorized to share the dataset at this time. USAID does make datasets publicly available, thus we expect they will be available in the future. Requests to access these datasets should be directed to drinfo@usaid.gov.

Ethics statement

The studies involving human participants were reviewed and approved by Universidad Iberoamericana (UNIBE).

Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

LS-V contributed substantially to the conception, design analysis, interpretation, drafted the work, and revised it critically. CV contributed substantially to the conception of the work, provided important intellectual content, and critical revisions. AM-R contributed substantially to the conception, design, and critical revisions and provided important intellectual content. CR-M contributed to the analysis and interpretation of the data, critical revisions, and provided important intellectual content. DC-B contributed substantially to the analysis and interpretation, drafted the work and revised it critically multiple times. All authors provided approval for publication of the content and agreed to be accountable for all aspects of the work.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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