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# COMPARING READING PROFILES OF BILITERATE LATINO/A CHILDREN IN ELEMENTARY SCHOOL: EVIDENCE FROM THE SIMPLE VIEW OF READING

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Comparing Reading Profiles of Biliterate Latino/a Children in Elementary School: Evidence from the simple view of reading.

Abstract:
In this correlational study, we analyzed data from 71 Spanish-English biliterate students in grades 3 (n=21), 4 (n=23), and 5 (n=27) with the goal of investigating the applicability of the Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) in English and in Spanish for this population. The simple view posits that decoding (the ability to read words) and linguistic comprehension (the ability to understand language) both contribute uniquely in predicting reading comprehension, but that they also theoretically and statistically interact with one another. Using this model, we sought to determine whether the reading process was comparable between Spanish, a transparent orthography, and English, an opaque orthography. We collected analogue measures of reading comprehension, real-word reading (a proxy for decoding), and language proficiency (measures of syntax, morphology, and broad vocabulary) in Spanish and English to model the Simple View. Results showed that, for Spanish, language skills and decoding both made significant contributions to reading comprehension, in line with theoretical predictions. However, no interactions between decoding and language were detected. In English, by contrast, decoding and language both made independent contributions to reading in addition to a significant interaction effect that showed students with weaker language skills benefitting more from decoding than students with stronger language skills.

Key words: Reading Comprehension, Simple View of Reading, Bilingual, Biliteracy, Language proficiency, Spanish

Resumen:
En este estudio, analizamos datos de una muestra de 71 estudiantes bilingües (español e inglés) en 3º, 4º, y 5º grado con el objetivo de investigar la aplicabilidad de la Perspectiva Sencilla de la Lectura (i.e., the Simple View of Reading; Gough & Tunmer, 1986; Hoover & Gough, 1990) en inglés y en español para esta población. Esta perspectiva sugiere que las habilidades de leer palabras (*decoding*) y comprender lenguaje (*linguistic comprehension*) hacen contribuciones únicas a la predicción de la comprensión de lectura, y que también son relacionadas entre si teóricamente y estadísticamente. Usanda este modelo, queríamos determinar si el proceso de la comprensión de lectura era comparable entre español, una ortografía transparente, e inglés, una ortografía opaca. Tomamos medidas de la comprensión de lectura, la lectura de palabras reales (para representar *decoding*), y de sintaxis, morfología, y vocabulario amplio (para representar *linguistic comprehension*), en inglés y español para modelar esta sencilla perspectiva. Los resultados indican que, para español, destrezas de *linguistic comprehension* y *decoding* contribuyeron significativamente a la comprensión de lectura, según predicciones teóricas. Sin embargo, no habían interacciones entre los dos variables. En inglés, destrezas de *decoding* y *linguistic comprehension* también hicieron contribuciones únicas, y además detectamos una interacción significativa que mostró que

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estudiantes con niveles bajos de lenguaje beneficiaron más de la habilidad de leer palabras que estudiantes con mejores habilidades de lenguaje.

Palabras clave: Comprensión de lectura, Simple View of Reading, bilingüe, habilidades de lenguaje, español.

The purpose of this study was to investigate the applicability of the Simple View of Reading (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990) separately in two languages (Spanish and English) among a sample of upper elementary Spanish-English bilingual children who were able to read in both languages (i.e., they were biliterate). The current research adds to the literature on the SVR in its investigation of Spanish reading as it compares with English. Since English is an opaque orthography (marked by many irregularities in pronunciations) and Spanish is orthographically transparent (consistent sound-symbol relationships), the relative contributions of word reading skills and language proficiency may differ across languages, providing insights into the nature of the reading process with implications for instruction, particularly in Spanish-English bilingual settings.

## 1. What is the Simple View of Reading?

The Simple View of Reading was developed to be a parsimonious model of English reading, and is unique in having been applied to non-native English speakers as well as to non-English languages. Across contexts, the SVR has been shown to be a robust quantitative model for explaining reading comprehension among elementary and middle school-aged children. According to the SVR, reading comprehension is comprised of two distinctive processes: decoding and linguistic comprehension. Decoding is the process of taking graphic information and converting it to linguistic form, whereby one reads the words, sentences, and paragraphs that are written on a page or screen. Comprehending what one reads, however, requires appropriate linguistic comprehension, defined as “the process by which, given lexical (i.e., word) information, sentences and discourses are interpreted» (Gough & Tunmer, 1986, p. 7).

When considering the relative contributions that decoding and linguistic comprehension make to reading comprehension, a developmental perspective is required (Hoover & Gough, 1990). For younger children who are first learning to read (i.e., around 6 years of age in the United States), decoding assumes the stronger predictive role in reading comprehension. This is because at this age children must devote significant cognitive energy to recognizing and sounding out novel words and sound combinations (see Laberge & Samuels, 1974). Fortunately, in most alphabetic languages decoding is a finite process, consisting of a limited number of letters and sounds. Thus, with some instruction and lots of practice, most typically developing children «crack the code» and become relatively efficient at word reading.

Over time, as decoding becomes increasingly automatic, the texts children have to read in the upper elementary and middle grades become increasingly complex. It is at this point in development that language skills are hypothesized to explain more variation in reading comprehension (Hoover & Gough, 1990). That is, when the reader accurately and efficiently decodes a text, he or she has successfully converted that graphic information into language, which must then be comprehended. Thus, linguistic comprehension is dependent on the semantic, lexical, and syntactical stores available to the reader (Perfetti, 1988). However, put simply, linguistic comprehension is the ability to understand language.

Gough and Tunmer (1986) argued the direct relationships that are hypothesized to exist between decoding (i.e., *D*) and linguistic comprehension (i.e., *LC*) as predictors of reading comprehension (RC) cannot be simply understood as D + LC (that is, an *additive* model). Such a model suggests, for example, that if one merely possesses LC, then he or she would be able to read for comprehension absent decoding skill, which is clearly impossible. Thus, the product of decoding and linguistic comprehension, i.e., D x LC, is added to the model. By establishing a multiplicative model, an individual whose decoding or linguistic comprehension skills were nonexistent (i.e. equal to 0), would possess no ability to read for comprehension. For example, a literate, monolingual English-speaking student could easily be taught to decode written Spanish. However, being unable to understand Spanish results in LC=0, and thus RC=0. By contrast, if D=0, one lacks the ability to convert graphic information into linguistic form. This total absence of D eliminates any possibility that LC processes will be activated through text interaction. In either case, if D or LC=0, then RC=0.

## 2. Intra-linguistic research on the Simple View

The majority of research carried out using the SVR as a theoretical and empirical framework has been conducted in English with monolingual English speakers (Joshi, Tao, Aaron, & Quiroz, 2012). Findings from this monolingual line of research have varied somewhat in the means by which decoding, linguistic comprehension, and reading comprehension are operationalized. Generally, however, the hypothe-

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sized roles of decoding (Adolf, Catts, & Little, 2006; Dreyer & Katz; Johnston & Kirby, 2006; 1992; Tilstra, McMaster, Van Den Broek, Kendeou, & Rapp, 2009) and linguistic comprehension (Adolf et al., 2006; Conners, 2009; Joshi & Aaron, 2000; Savage, 2006; Tilstra et al., 2009) emerge as stable predictors of reading comprehension.

Some research has found that augmenting the SVR model with additional predictors explains additional variation in reading comprehension, while other work shows that adding unique predictors to the SVR model allows for the estimation and testing of mediation hypotheses. For example, Tilstra et al. (2009) worked with 271 students in fourth, seventh, and ninth grade, finding that, among fourth graders, performance in providing verbal definitions for words (metalinguistic knowledge) predicted an additional 18 percent of variation in reading comprehension when the variable was entered into regression models before listening comprehension. However, when entered into the regression model after listening comprehension, it only explained an additional five percent of variation, suggesting a good amount of shared variance between the two measures with reading comprehension. Silverman, Speece, Harring, and Ritchey (2012) worked with 248 fourth grade students and found that adding a fluency measure to the SVR eliminated the significance of the direct relationship between decoding and reading comprehension. Instead, decoding was significantly predictive of fluency, which in turn predicted reading comprehension. There are many examples of researchers augmenting the SVR in monolingual research. However, one inescapable conclusion from the breadth of research in this domain is that the essential components of the SVR appear to serve as a sort of «psycholinguistic nucleus» (Proctor, 2006) for understanding the reading process among English monolingual children.

## 3. The Simple View in multilingual contexts

Despite the simplicity of the model (or perhaps because of it), the SVR is distinctive from other empirically-testable models of reading comprehension due to its relatively broad application to Spanish-English bilingual children who are learning to read in English (e.g., Gottardo & Mueller, 2009; Mancilla-Martínez, Kieffer, Biancarosa, Christodolou, & Snow, 2011; Proctor, Carlo, August, & Snow, 2005), and for its more recent applications to non-English languages, with a notable emphasis on the role of orthography in understanding reading development in the context of the SVR (e.g., Florit & Cain, 2011; Joshi et al., 2012; Protopapas, Mouzaki, Sideris, Kotsolakou, & Simos, 2013; Verhoeven & vanLeeuw, 2012). Here we review the broad findings in these two domains of reading research.

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### 3.1. *English SVR with Spanish-English Bilingual Learners*

One of the first rigorous tests of the SVR was conducted with a longitudinal sample of Spanish-English bilingual children in first through fourth grade (Hoover & Gough, 1990). Grade-level cross-sectional analyses addressed three hypotheses: 1) that D x LC explained unique variance in reading comprehension above that of D + LC; 2) for less skilled readers, the relationship between decoding and linguistic comprehension would be weaker; 3) changes in D would affect the relationship between LC and RC. Results supported all three hypotheses. Understanding the interactions between decoding and linguistic comprehension were deemed crucial for articulating cogent models of reading comprehension, particularly as they pertained to reading instruction in schools.

Subsequently, a good deal of English SVR research with Spanish-English bilingual children in the U.S. has been conducted, and provides additional developmental nuance to Hoover & Gough's (1990) early findings. In the early grades, when children are in their first years of exposure to reading instruction, Gottardo and Mueller (2009) tested a bilingual SVR model with a group of 131 first and second grade Spanish-English bilingual children. Results were consistent with SVR in that English D and LC made significant contributions to English RC, with the effect of decoding substantially stronger (B=.81) than that of linguistic comprehension (B=.21). However, no D x LC interactions were tested.

In the middle elementary grades, Proctor et al. (2005) worked with a sample of 135 Spanish-English fourth grade bilingual students and found that decoding and linguistic comprehension made contributions to reading comprehension, with the effect of linguistic comprehension being substantially stronger (total B=.67) than that of decoding (total B=.3). While the main effect finding was consistent with the SVR, all interaction testing was non-significant. Lesaux et al. (2010) worked with 87 Spanish-English bilingual children in fourth and fifth grades to test the SVR, but with no interaction testing. Findings showed a strong and significant relationship between linguistic comprehension and reading, with a non-significant effect of decoding.

Finally, in early secondary settings, Mancilla-Martínez et al. (2011) revealed some unusual findings. Following a cohort of 55 Spanish-English bilingual students from the beginning of fifth grade through the beginning of seventh grade (final n=43) Mancilla-Martínez et al. (2011) used growth modeling techniques to estimate reading growth trajectories, and assessed the effects of fifth grade decoding and linguistic comprehension on fifth grade reading comprehension and its growth over time. Contrary to SVR hypotheses, findings suggested a stronger effect of decoding ($\gamma$=.56) on reading comprehension than for linguistic comprehension ($\gamma$=.3). Thus, while most research in this domain appears to support at least the main effects component of the SVR, most studies of the English SVR have neglected the interaction dimension of the model (Gottardo & Mueller, 2009; Lesaux et al., 2010; Mancilla-Martínez et al., 2011), or found interactions to be non-significant (Proctor et al., 2005). Only Hoover and Gough (1990), in their original research conducted with Spanish-English bilingual students, found the interaction component of the SVR to improve the fit of the model. Given the limited range of studies with Spanish-English bilinguals that have tested the model as originally specified, more research is needed.

### 3.2. *SVR Research in non-English Languages*

In addition to having been tested, indeed conceptualized, with Spanish-English bilingual learners in the U.S., the SVR has also been modeled in languages other than English. Most of these studies were designed as empirical ruminations on the potential distinctiveness of the SVR in languages characterized by transparent orthographies. Specifically, the frequency of irregular spellings and pronunciations that characterize written English (i.e., the opacity of the orthography) create greater demands on learning to decode. As a result, decoding skill predicts large percentages of variation for younger children as compared with that of linguistic comprehension. However, for emergent readers of languages whose orthographies are transparent, decoding processes are typically mastered far more quickly. As a result, researchers who have conducted SVR studies in such languages hypothesize, and typically find, that the effects of decoding on reading comprehension become less predictive sooner than is typical in English.

Florit and Cain (2011) conducted a meta-analysis to explore this question. They sought to determine whether the relationships between LC and RC were stronger, and relationships between D and LC were weaker, at earlier levels of exposure to reading. The authors reviewed SVR studies conducted in English and compared findings with studies conducted in non-English languages with transparent orthographies (including Dutch, Finnish, French, German, Greek, Italian, Norwegian, and Spanish), taking into account the amount of time students had been exposed to formal reading instruction in the target language (i.e., 1 - 2 years of exposure vs. 3 - 5 years of exposure).

In English, for children who had been exposed to formal reading instruction for 1 - 2 years, Florit and Cain (2011) found average correlations between D and RC were .83 for nonword decoding and .80 for real word decoding, while the correlation between LC and RC was .38. For children having had between 3 - 5 years

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of reading instruction, the role of decoding was decreased (to .61 and .78 respectively for non-word and word decoding), while the correlation between linguistic comprehension and reading comprehension rose to .71. By contrast, in transparent orthographies, the average correlation between D and RC for 1 - 2 years of exposure was .36 (for real word reading only; there were no studies that used non-word reading indicators) and the average correlation between LC and RC was .50. The correlations for studies that included students with 3 - 5 years of exposure to reading instruction were .45 and .68 for D and LC on RC, respectively. Thus, the role of D on RC remained relatively stable in these languages as compared with English, while the role of LC on RC was comparable across all languages.

More recent research has continued this line of inquiry, with increasing numbers of studies from young readers of Dutch (Verhoeven & van Leeuwe, 2012), Greek (Kendeou, Papadopoulos, & Kotzapoulou, 2013; Protopapas, Mouzaki, Sideris, Kotsolakou, & Simos, 2013; Protopapas, Simos, Sideridis, & Mouzaki, 2012), Norwegian (Høien-Tengesdal, 2010), Malay (Lee & Wheldall, 2009), and Spanish (Joshi et al., 2012; Proctor, August, Snow, & Barr, 2010). All studies point to the utility of the SVR in these different languages (and for Chinese as well; see Joshi et al., 2012). Interestingly, across all studies of the SVR conducted with non-English languages, only 3 modeled the SVR for Spanish (Joshi et al., 2012; Proctor et al., 2006, 2010). Thus, more research on the SVR in Spanish and English for Spanish-English bilinguals is warranted.



## 4. The Present Study

The present study was designed to address the two major strands of research presented above. First, we sought to expand the research base on the SVR in English as it is applied to Spanish-English bilingual learners in elementary school. Second, we sought to similarly expand the research base on the SVR as it is applied in languages that are characterized by a transparent orthography, in this case Spanish, for which there exists only a limited amount of research. To accomplish this, we worked with a sample of 71 Spanish-English bilingual and biliterate Latino/a children in grades 3 - 5 in two school districts in the United States. We collected data, in Spanish and English, on analogue measures of real word reading (decoding) as well as syntax, morphology, and vocabulary knowledge (i.e., linguistic comprehension), and reading comprehension. We used structural equation modeling to test the SVR in both languages, assessing the main effects of D and LC on reading comprehension, followed by testing the interaction effect (D × LC). For each language the best fitting model was identified.

## 5. Method

**Participants.** Participants were part of a larger three-year study of language and literacy development among Spanish-English bilingual children in the United States from one school district in Massachusetts and one school district in Maryland. The language of all classroom instruction in both districts was exclusively English. The initial pool of bilingual students in our sample consisted of 123 children in Grades 3 (n=44), 4 (n=45), and 5 (n=34). All of these children were able to read in English; however, not all the children were able to read in Spanish, due to the fact that few children had received formal Spanish reading instruction.

Since all schooling instruction was in English, we needed to determine which participating children could be reasonably expected to attempt the Spanish reading comprehension measure. To do this, we decided that students would need, at the very least, to show some emergent ability to read simple, high frequency Spanish words, which would allow for sentence-level processing like that required by the reading comprehension assessment we used for the study (see Measures section below).

We began our assessment of the students' Spanish decoding skills with the first six words that start the real word reading section of the Woodcock-Muñoz Language Survey - Revised (WMLS-R; Woodcock, Muñoz-Sandoval, Reuf, & Alvarado, 2005) *Identificación de letras y palabras* subtest. The initial six Spanish words were *una, ser, al, del, lápiz,* and *suyo*. Students who were able to read all six words correctly, completed the assessment to ceiling (see Measures section) and were subsequently assessed for Spanish reading. Students who misread one or more of these words were not considered for the current study (see Proctor & Silverman, 2011 for additional details). Of the initial 123 students, 71 met that basic threshold for Spanish reading. In Grade 3 there were 21 students; in Grade 4, there were 23 students; and in Grade 5 there were 27 students. Twenty-four of the students were from the Massachusetts district, while 47 were from the Maryland district. Fifty-six percent of the sample was female, 94 percent of the sample received free or reduced lunch from their respective schools, 63 percent were classified as limited in English proficiency, and 76 percent of the students were born in the U.S.

**Procedure.** Data were collected in the Spring of the 2009 - 2010 academic year. For each language, children were assessed on decoding (1 measure), linguistic comprehension (3 measures), and reading comprehension (1 measure). Trained graduate research assistants, who were native speakers, or fluent second language speakers, of the language of the assessment, individually administered all measures.

**Measures.** All measures were administered in Spanish and English. The test formats and scoring procedures were the same for each measure whether it was administered in Spanish or English, thus allowing for direct score comparison across languages (e.g., comparing word reading performance in Spanish with word reading performance in English).

***Decoding.*** The WMLS-R (Woodcock et al., 2005) Letter-Word Identification subtest was used to operationalize decoding. On this measure, students were presented a list of real Spanish or English words ordered by increasing difficulty until 6 consecutive items were read incorrectly. In English, the internal reliability of this subtest is .98 for 8-year-old children and .96 for 11-year-olds (Woodcock et al., 2005). Standard scores (mean=100, SD=15) were used for all analyses.

***Linguistic Comprehension.*** Mancilla-Martínez et al. (2011) contend that research on the SVR ought to operationalize LC using taking into account semantic (or word-level) knowledge «in addition to syntactic skills» (p. 351). We thus characterize LC with indicators of broad vocabulary as well as syntax. Additionally, given its established role as a linguistic predictor of reading comprehension (see Kieffer & Lesaux, 2008), we included an indicator of morphological awareness, in order to obtain a more robust indicator of the construct.

***Vocabulary***. Vocabulary was assessed using the WMLS-R Picture Vocabulary subtest. In this task, students were shown pictured items ordered by increasing difficulty and were asked to say aloud the names of each picture. Testing was discontinued after a student missed 6 consecutive items. Form A was administered to students. The internal reliability for children 8 and 11 years old on the English picture vocabulary test is .90 and .92 respectively (Woodcock et al., 2005). Standard scores (mean=100, SD=15) were used in all analyses.

***Syntax.*** Syntax was assessed using the *Clinical Evaluation of Language Fundamentals* (CELF; Semel, Wiig, & Secord, 2003) Formulated Sentences subtest. On this task, students were shown a picture and given a target word that was to be used in a single sentence that described the picture. For example, a sample target word on this measure is *children,* which is accompanied by a picture of two children playing a video game. One common response to this prompt is the utterance, «The children are playing a video game». Scores were calculated on a 0-2 coding scheme in which 0 indicated any of the following: Incomplete sentence; complete sentence with two or more deviations in syntax or semantics; complete sentence that is not meaningful; or failure to use the stimulus word; failure to reference the stimulus picture. A response that received a 1 was a complete sentence that demonstrated correct structure and had only one or two deviations in syntax or semantics. Finally, a score of 2 represented a complete sentence that was semantically and syntactically correct and used a correct logical structure that was meaningful, complete, and grammatical. Testing was discontinued after a student responded incorrectly (i.e., scored 0) on 5 consecutive items. Test-retest reliability as reported in the CELF manual is .74-.79 for children ages 7.0-9.11 and internal consistency is .80-.82 for these same ages. Raw scores were used in all analyses as this measure was administered identically across all three grade levels, resulting in out-of-level raw scores that could not be standardized by age.

***Morphology***. Morphology was measured using the *Extract the Base* test (Anglin, 1993; August, Kenyon, Malabonga, Louguit, & Caglarcan, 2001; Carlisle, 1988). The test requires students to extract the base from a derived word (e.g., *farm* from *farmer*) when an examiner read aloud a target word (e.g., *farmer*) along with a contextual sentence (e.g., My uncle works on a __). Students had worksheets showing the target words and sentences so they were able to follow the reading aloud of the prompt. Students then wrote the appropriate response in the blank area. Scores were calculated on a 0-1 coding scheme, where 0 indicated an incorrect response and 1 indicated a correct response that may or may not have been correctly spelled. If an item was incorrectly spelled, in order to receive credit, it must have been spelled in a phonologically plausible way (e.g., *proced* instead of *proceed*). August et al. (2001) report Rasch-based reliability at .98. Raw scores were used in all analyses as standard scores are not available for this measure.

***Reading Comprehension.*** The WMLS-R Passage Comprehension subtest was used to capture this construct. In this measure, students silently read cloze passages in order of increasing difficulty and produced an oral response to an unfinished sentence. The examiner then marked the response as correct or incorrect. The internal reliability of the English passage comprehension assessment for children between 8.0 and 11.0 years old is .81-.91 (Woodcock et al., 2005). Standard scores (mean=100, SD=15) were used for analyses.

**Analytic Plan.** Structural equation modeling (SEM) was used to fit two identical SVR models (one in English, one in Spanish) to the language and literacy data collected from the students. SEM is comprised of two sets of equations; the first set relates measured variables to latent variables while the second set defines the relations between the latent variables in the model. A general schematic of the interaction latent regression model under investigation is displayed in Figure 1.

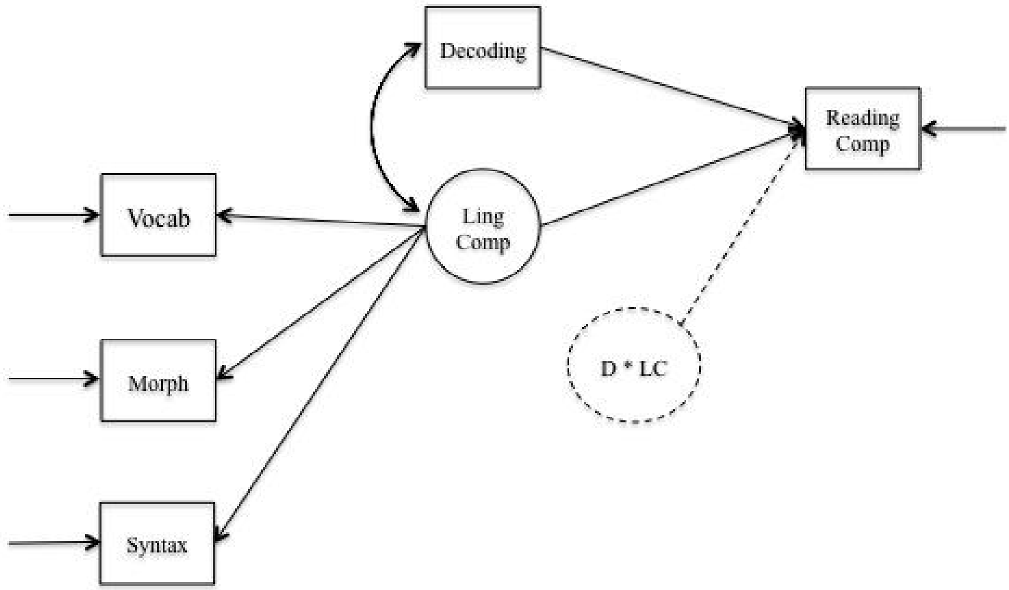


*Figure 1*. Path diagram of the additive relation between latent linguistic comprehension and decoding on reading comprehension. Note the interaction between decoding and linguistic comprehension (- - -) augments the additive regression model and will be tested separately.

The structural equation for the English and Spanish SVR models is represented as:

$$RC_i = \gamma_0 + \gamma_1 (D)_i + \gamma_2 (LC)_i + \gamma_3 (D \times LC)_i + d_i$$

The additive regression model (i.e., RC=D + LC) was compared to the interaction model (i.e., RC=D + LC + [D x LC]) using a difference in second-order bias correction version of Akaike's information criteria, denoted as $AIC_c$ (see, e.g., Hurvich & Tsai 1989, 1995; Sugiura 1978), with smaller values representing better model fit. Thus, the change from the *additive* model (RC=D + LC) to the *interaction* model (RC=D + LC + [D x LC]) is assessed by the change in $AIC_c$, as represented by $\Delta_i$. A large value of $\Delta_i$ (i.e., ≥ 10) indicates that the interaction model better fits the data as compared with the additive approach, while a small change value (i.e, ≤ 2) indicates that the additive model is better fitting to the data.

## 6. Results

### 6.1. *Descriptive statistics and comparisons across languages*

Table 1 presents the means, standard deviations, and min - max values for each measured variable. Paired sample *t*-tests were calculated for each construct in English and Spanish to determine relative strengths and weaknesses of the sample. In English, the students' reading comprehension performance was within a standard deviation of average (92.28), while in Spanish reading performance was more than 1 standard deviation below the standardized mean, at 83.43, which was a significant difference ($t(64)=4.6$, $p=.000$). Similar trends held for morphology and syntax, in which students' English proficiency was significantly different from their Spanish proficiency (see Table 1). On the measure of expressive vocabulary, however, students were approximately 1 standard deviation below the mean, with no significant difference between languages. Finally, students' Spanish and English decoding skills were significantly different from one another ($t(66)=1.99$, $p=.05$), this time in favor of Spanish. Decoding in both languages was comparable to monolingual averages (105.51 in Spanish vs. 100.46 in English).

Note that, while students were in grades 3, 4, and 5, the use of standard scores for reading comprehension, decoding, and vocabulary controlled for age. There were no grade-level differences detected for the raw score indicators of syntax or morphology in Spanish or English (*F*s ranged from .173 - 1.25, all *p*s ≥ .295).

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Table 1.
Descriptive Statistics and Results from Paired t-tests for Reading, Decoding, and Linguistic Comprehension Indicators

| | **Mean** | **SD** | **Min-Max** | **t** | **df** | **p** |
|---|---|---|---|---|---|---|
| Reading Comp | | | | | | |
| Spanish | 83.43 | 11.28 | 45 - 117 | 4.6 | 64 | .000 |
| English | 92.28 | 12.16 | 48 - 117 | | | |
| Decoding | | | | | | |
| Spanish | 105.51 | 19.61 | 54 - 140 | -1.99 | 66 | .050 |
| English | 100.46 | 13.52 | 70 - 127 | | | |
| Linguistic Comp | | | | | | |
| Spanish Vocab | 83.88 | 21.04 | 24 - 136 | 1.12 | 64 | .267 |
| English Vocab | 88.28 | 19.01 | 34 - 124 | | | |

| | **Mean** | **SD** | **Min-Max** | **t** | **df** | **p** |
|---|---|---|---|---|---|---|
| Spanish Morph | 19.1 | 5.84 | 6 – 29 | 3.33 | 62 | .001 |
| English Morph | 22.59 | 4.7 | 4 – 28 | | | |
| Spanish Syntax | 26.54 | 8.26 | 3 – 43 | 2.25 | 68 | .028 |
| English Syntax | 29.29 | 10.86 | 8 – 54 | | | |

Table 2 presents the correlations between the observed variables and can be examined both intra-and cross-linguistically. Within English, all decoding and linguistic variables correlated strongly and significantly with reading comprehension, save for the weaker (though still significant) relationship between syntax and reading comprehension. In Spanish, however, correlations were less strong, though still significant, save for the non-significant relationship between vocabulary and reading comprehension. Cross-linguistically, English decoding showed a weak positive correlation with Spanish decoding and reading comprehension ($r$=.261 and .251, respectively, $p < .05$). English vocabulary was negatively and significantly associated with Spanish vocabulary and morphology. Finally, the strongest cross-linguistic association was positive, and between English and Spanish syntax ($r$=.463, $p < .05$).

Table 2.
Correlations Among English and Spanish Observed Variables

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| English | | | | | | | | | |
| 1. Reading Comp | | | | | | | | | |
| 2. Decoding | **0.635** | | | | | | | | |
| 3. Vocabulary | 0.682 | 0.631 | | | | | | | |
| 4. Morphology | **0.702** | **0.699** | **0.748** | | | | | | |
| 5. Syntax | **0.365** | 0.135 | **0.444** | **0.441** | | | | | |
| Spanish | | | | | | | | | |
| 6. Reading Comp | 0.125 | **0.251** | 0.096 | 0.171 | 0.036 | | | | |
| 7. Decoding | 0.16 | **0.261** | 0.126 | -0.026 | -0.19 | **0.407** | | | |
| 8. Vocabulary | -0.148 | -0.092 | **-0.252** | -0.233 | 0.095 | 0.182 | -0.022 | | |
| 9. Morphology | -0.225 | -0.025 | **-0.275** | -0.241 | -0.01 | **0.406** | **0.27** | **0.36** | |
| 10. Syntax | 0.139 | -0.058 | -0.029 | 0.049 | **0.463** | **0.334** | -0.025 | **0.265** | **0.394** |

*Note.* Correlations in **bold** indicate $p$-values < 0.05

## 6.2. *Structural Equation Model Testing*

Table 3 compares the additive model (RC=D + LC) with the interaction model (RC=D + LC + [D x LC]) for both English and Spanish, where fit statistics for each set of models are displayed. For the Spanish variables, the main effects model fit better than the interaction model ($AIC_{C(min)=}$2689.64) with a very low change score ($\Delta_i$=0.06), while for the English variables, the interaction model fit better than the main effects model ($AIC_{C(min)=}$2394.143) with a large change in AIC ($\Delta_i$=20.68). These results have implications for the visual representation of the SVR in each language.

Table 3.
Structural Equation Model Testing for English and Spanish Simple View Models

| Spanish Models | $\chi^2$ | df | P | CFI | $AIC_C$ | $\Delta_i$ |
|---|---|---|---|---|---|---|
| $RC_i = \gamma_0 + \gamma_1 D_i + \gamma_2 LC$ | 7.72 | 4 | 0.102 | 0.921 | 2689.64 | |
| $RC_i = \gamma_0 + \gamma_1 D_i + \gamma_2 LC + \gamma_3 (D \times LC) + d_i$ | – – | – – | – – | – – | 2689.70 | 0.06 |
| English Models | | | | | | |
| $RC_i = \gamma_0 + \gamma_1 D_i + \gamma_2 LC$ | 11.63 | 4 | 0.020 | 0.956 | 2414.81 | |
| $RC_i = \gamma_0 + \gamma_1 D_i + \gamma_2 LC + \gamma_3 (D \times LC) + d_i$ | – – | – – | – – | – – | 2394.13 | 20.68 |

*Note.* RC=reading comprehension, LC=linguistic comprehension, D=decoding.

Tables 4 and 5 detail the parameter estimates for the best-fitting Spanish (additive) and English (interaction) models. For Spanish, the additive regression model coefficient for D was statistically significant at the $\alpha$=0.05 level, with a standardized effect of=γ .30 on reading comprehension, while the coefficient for LC was also statistically significant with a standardized effect of $\gamma$=.47. For English, effects of D and LC were both statistically significant, as was the interaction between D and LC. However, it was D that exerted the strongest standardized effect of the three terms ($\gamma$=.50), followed by LC ($\gamma$=.20), and their interaction (D x LC; $\gamma$=-.12).

Table 4
Parameter Estimates, Standard Errors, and Standardized Coefficients for the Spanish Simple View of Reading

| Parameter | Estimate | Standard Error | p-value | Standardized Coefficients |
|---|---|---|---|---|
| $\gamma_0$ | 37.99 | 18.59 | 0.041 | n/a |
| $\gamma_1$ | 0.17 | 0.06 | 0.006 | 0.30 |
| $\gamma_2$ | 0.54 | 0.22 | 0.014 | 0.47 |
| $\gamma_3$ | n/a | n/a | n/a | n/a |



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Table 5

Parameter Estimates, Standard Errors, and Standardized Coefficients for the English Simple View of Reading

| Parameter | Estimate | Standard Error | p-value | Standardized Coefficients |
|---|---|---|---|---|
| $\gamma_0$ | 55.89 | 12.38 | <0.001 | n/a |
| $\gamma_1$ | 0.96 | 0.48 | 0.045 | 0.50 |
| $\gamma_2$ | 0.43 | 0.14 | 0.002 | 0.20 |
| $\gamma_3$ | -0.01 | 0.004 | 0.038 | -0.12 |

Figures 2 and 3 graphically display the Spanish main effects results as a path model with standardized coefficients (Figure 2), while the English interaction model is better represented as a graph due to the added complexity introduced by the significance of the interaction term. Specifically, to examine the interaction in more detail, a graph of reading comprehension on decoding for low, medium, and high values of latent linguistic comprehension is shown (see Figure 3). Here decoding is centered and its range spans the central 95% of the distribution (i.e., +/- 2 SD). At low levels of decoding, differences in reading comprehension among the three levels of linguistic comprehension are substantial with those individuals with higher levels (i.e., 75$^{th}$ percentile of LC) having the highest reading comprehension scores. Individuals with medium and low levels of LC, respectively, produced lower levels of reading comprehension. In contrast, at higher levels of decoding the differences in reading comprehension between the three levels of LC dramatically decrease. For example, at D=-20, the estimated reading comprehension scores for the three LC levels are 84.8, 91.9, and 99.0, whereas at D=20, they converge to 92.7, 95.2, and 97.8.

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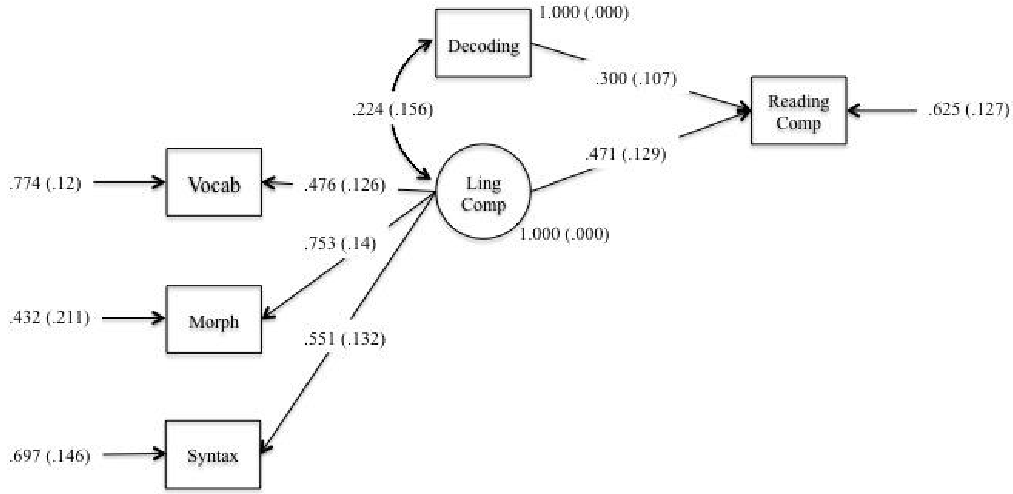


*Figure 2*. Best-fitting model for Spanish reading comprehension, without D x LC interaction.

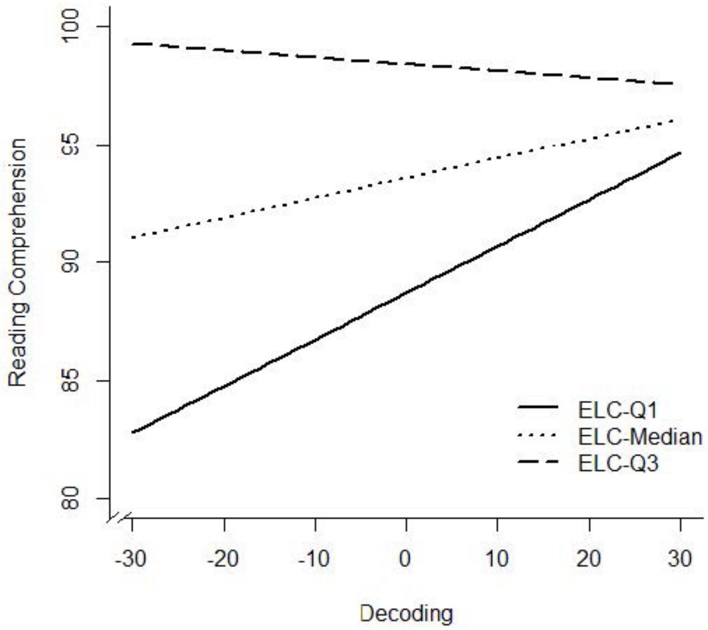


*Figure 3*. Plot of the best-fitting model for English reading comprehension, including interaction between latent linguistic comprehension and decoding. The three functions correspond to the quartiles of linguistic comprehension. *Note.* ELC=English Linguistic Comprehension; Q1=first quartile, or 25th %ile; Q3=third quartile, or 75th %ile.

## 7. Discussion

The current study was designed to add to the SVR research base by testing the model with a sample of Spanish-English bilingual students in two ways. First, we investigated the SVR in English. Then, we examined the SVR in Spanish and compared the results to the analysis of SVR in English. The findings have implications for understanding reading processes for bilingual students across languages. The findings also raise questions about language of instruction and the means by which it may be implicated in affecting how decoding and language operate to predict reading outcomes.

### 7.1. *The SVR in English*

The current study was designed to investigate the usefulness of the SVR in both Spanish and English for children who were able to read in both of these languages. To our knowledge, no SVR study has applied the model in two languages to a sample of bilingual and biliterate readers.

Research on SVR in English with upper elementary students has been contradictory on the relative role of decoding versus linguistic comprehension in predicting reading comprehension. While most studies have shown that linguistic comprehension exerts a stronger role than decoding at this stage of development (e.g., Florit & Cain, 2011), some studies have suggested that decoding actually plays a stronger role than linguistic awareness (Mancilla-Martínez et al., 2011). Contrary to the original conceptualization of the SVR, most studies have not identified a significant the interaction between D and LC, which would suggest that the role of D on RC depends on the level of LC and vice versa.

In the current study, the enduring influence of D, even in upper elementary school, was evident. Specifically, the standardized effects for D, LC, and D x LC suggest that the strongest contribution to RC was from decoding ($\gamma$=.50), followed by linguistic comprehension ($\gamma$=.20), and finally by the interaction term ($\gamma$=-.12). This finding is remarkably consistent with results detailed in Mancilla-Martínez et al. (2011), who also found that decoding skills contributed more strongly to reading comprehension than did linguistic comprehension. In the current study, however, the interaction between D and LC was significant, showing that the relative influence of LC versus D depended on the level of LC the students had obtained. Specifically, at lower levels of LC, D exerted a stronger role in RC while at higher levels of LC, D played a weaker role in RC. These results map to Hoover and Gough's (1990) initial hypotheses, specifically that including the multiplicati-

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ve combination of D x LC results in a better fitting model than one with just the additive contribution of D + LC. These results also confirm the contention that weak decoding, coupled with weak linguistic comprehension result in poor reading comprehension (Hoover & Gough, 1990), but they also suggest that students with lower LC may compensate by relying on D for reading comprehension, which may result in shallow understanding of text content. Given that, in the upper elementary grades, students are expected to learn from reading text, additional focus on supporting the LC of students in these grades is warranted. Indeed, holding decoding levels to average (i.e., 100), the differences in reading comprehension outcomes as a function of linguistic comprehension were notable. For an average decoder, the difference in reading comprehension for student at the 25$^{th}$ and 75$^{th}$ percentiles of LC equated to a moderate effect size ($d$ =.67). Such a result affirms the importance of LC for students who are typical decoders.

It is a departure from previous research that high levels of decoding offset the effect of LC on RC for upper elementary-aged students with lower linguistic comprehension. This may be related to the use of the WMLS-R Passage Comprehension subtest to operationalize reading comprehension, as this measure has been shown to be particularly sensitive to decoding skill (Francis et al., 2006; Keenan, Betjemann, & Olson, 2008). Thus, in a sentence-based cloze measure such as the WMLS-R Passage Comprehension subtest, higher levels of decoding are likely to close language-based differences. More reading research that models reading comprehension as a latent variable comprised of distinctive indicators of comprehension is warranted.

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### 7.2. *The Spanish SVR*

Unlike English, the SVR in Spanish was a more straightforward analysis in that the interaction term did not improve the fit of the model, and the standardized effects of D and LC on RC conformed to hypothesized expectations of the SVR. Florit and Cain (2011) found that the average correlation between D and RC for readers of transparent orthographies was .45 (95% CI=.40 - .50) while between LC and RC the average correlation was .68 (95% CI=.66 - .71). In the current study, the standardized paths between D and RC ($\gamma$=.30), and LC and RC ($\gamma$=.47) were different, however the relative effects were comparable. Thus decoding and linguistic comprehension were less strongly associated with reading comprehension here than has been found across SVR studies with transparent orthographies.

There are a number of possible interpretations for the finding that the interaction term did not improve the fit of the Spanish SVR model. However, little research on the SVR in Spanish exists that can inform our understandings. Joshi et al. (2012) found that, in grade 3, decoding exerted a weaker effect on reading comprehension than linguistic comprehension, which is consistent with the current findings. However, Joshi et al. (2012) also found that the interaction term for D × LC explained substantial variation (60%) in RC in Spanish, which was not the case in the current study. More research is needed in this domain so as to inform our understanding of Spanish reading development among U.S. populations of Spanish-English bilingual children.

### 7.3. *Educational Implications*

The educational implications of the current study are clearer for the English results than they are for Spanish. Because the language of classroom instruction for all students was English, these results give further support to the need to focus on English language development in U.S. classrooms with bilingual learners. While unusually high levels of decoding (i.e., +2 standard deviations above the mean) offset the effects of language on reading comprehension, the more realistic interpretation of these results should be centered on the effects of language given average decoding skill (i.e., 100). When held constant, the effect of high versus low language proficiency predicting reading was substantial ($d$=.67). Indeed, the literature on bilingual learners' reading has converged on the conclusion that decoding skills typically develop to comparable levels among both bilingual and monolingual children (see Lesaux, 2006 for a review). We are left, then, with a clear need to promote English language development to push on improving comprehension outcomes for bilingual students. To this end, teachers should target academic vocabulary and its associated constructs (morphology and syntax; see Uccelli & Meneses, this issue), use small-group discussions, and provide consistent and structured opportunities for writing across content areas and written genres (see Baker et al., 2014; Brisk, 2014).

Results with respect to Spanish raise natural questions about the language of literacy instruction. The fact that the students in this sample did not receive formal Spanish literacy instruction is evident in their reading comprehension scores, which were more than 2 standard deviations below the norming sample mean. Would these relationships be different had the students received bilingual instruction in their schools, and were thus able to read in Spanish at levels comparable to their English (which was in the average range)? The answer to this question ought to be the focus of future SVR research. In this study, the students, even without instruction, navigated Spanish decoding with relative ease, likely due to the orthographic

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overlap between Spanish and English. With Spanish literacy instruction, students would receive formal decoding instruction at school, and would likely perform to even higher levels that currently reported. However, the types of words encountered at higher levels of traditional word reading measures are highly unlikely to occur with any regularity in traditional texts, and as such, a law of diminishing returns is likely to accrue to decoding as it predicts comprehension (Florit & Cain, 2011). Similarly, given Spanish language instruction, language proficiency would also reach levels substantially higher than documented here, with implications for improved reading outcomes. Perhaps increasing average performance and variation in D and LC would result in the type of D x LC interaction that was missing from the current study. This is an open question for future research.

Finally, in considering future research of the SVR in the presence of bilingual instruction, researchers ought to think more openly about the cross-linguistic associations that might arise when academic language is developed to high levels in both Spanish and English. While some modest SVR cross-linguistic findings have been reported among Spanish-English bilinguals enrolled in bilingual programming (e.g., Nakamoto, Lindsey, & Manis, 2008; Proctor, August, Carlo, & Snow, 2006), findings are mixed (see Lesaux et al., 2010), and in each of these cases, bilingual instruction was transitional, such that Spanish was developed only to moderate levels. Studies of the SVR in maintenance bilingual programs would shed important light on the cross-lingusitic nature of SVR among (relatively) balanced bilingual and biliterate children.

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