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The Structure of Oral Language and Reading and Their Relation to Comprehension in Kindergarten through Grade 2

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Abstract

This study examined the structure of oral language and reading and their relation to comprehension from a latent variable modeling perspective in Kindergarten, Grade 1, and Grade 2. Participants were students in Kindergarten ($n = 218$), Grade 1 ($n = 372$), and Grade 2 ($n = 273$), attending Title 1 schools. Students were administered phonological awareness, syntax, vocabulary, listening comprehension, and decoding fluency measures in mid-year. Outcome measures included a listening comprehension measure in Kindergarten and a reading comprehension test in Grades 1 and 2. In Kindergarten, oral language (consisting of listening comprehension, syntax, and vocabulary) shared variance with phonological awareness in predicting a listening comprehension outcome. However, in Grades 1 and 2, phonological awareness was no longer predictive of reading comprehension when decoding fluency and oral language were included in the model. In Grades 1 and 2, oral language and decoding fluency were significant predictors of reading comprehension.

Keywords

Oral language; Beginning reading; Literacy; Reading comprehension; Structural equation modeling

Learning to read requires an array of linguistic skills in order to ensure successful comprehension. Critical to recognizing words is the ability to connect graphic units to phonological segments. However, decoding the pronunciation of a word may not yield lexical understanding and, therefore, vocabulary knowledge is also an important skill in learning to read. Another linguistic skill that is foundational to the reading process is knowledge of the structural features of language, that is, syntactic knowledge. Longitudinal studies starting in Kindergarten show both vocabulary and syntax to be important predictors of later reading success (Catts, Fey, Zhang, & Tomblin, 1999; Muter, Hulme, Snowling, & Stevenson, 2004) and also to differentiate good and poor readers (e.g., Catts et al., 1999). However, longitudinal studies in the early grades often do not show that oral language contributes unique variance to reading outcomes (Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004; Storch & Whitehurst, 2002).

To better understand the role of oral language measures of vocabulary, syntax, and listening comprehension in learning to read, we designed the current study to examine their relation with phonological awareness in predicting listening comprehension in Kindergarten and reading comprehension in Grades 1 and 2. We added listening comprehension as a predictor in all three grades and decoding fluency as a predictor in Grades 1 and 2 because reading success is often described as a product of decoding and language comprehension in the Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990). To account for the inter-relatedness of these predictors, we examined their relations from a latent variable modeling perspective.

The role of vocabulary and syntax in learning to read and comprehend text

Understanding spoken and written language requires that the meaning of words and sentences be integrated into a mental model of the text (Perfetti & Stafura, 2014). Contributing to this integration are world knowledge, motivation, and system architecture issues such as limitations in working memory or executive functioning that are beyond the scope of this study. To measure word meanings researchers typically administer expressive and receptive vocabulary tests that assess lexical depth and breadth. To measure the structural features of language (i.e., syntax) researchers often administer oral tasks that require grammatical judgments or the repetition of sentences with increasingly complex grammatical structures.

A controversial question is the exact role of vocabulary and syntactic knowledge in learning to read. Some researchers argue that all oral language correlates of poor word reading, including vocabulary and syntactic skills, have their genesis in weak phonological awareness (Shankweiler, Crain, Brady, & Macaruso, 1992). According to this view, weak phonological representations jeopardize lexical quality and undermine word recognition processes. Furthermore, according to the lexical restructuring model (Walley, Metsala, & Garlock, 2003), the more entries available in the lexicon, the more fully specified phonological representations will be. Thus, one might expect strong phonological awareness to coincide with strong oral vocabulary and strong word recognition processes. However, there is little support for significant effects of oral vocabulary on word recognition (e.g., Muter et al., 2004), although Ouellette and Beers (2010) found that vocabulary did predict irregular word recognition in first grade. Ouelette and Beers suggest that irregular word reading taps orthographic processing and, therefore, benefits from fuller and deeper semantic representations than those afforded by representations of words with consistent sound-spelling patterns. Another way to explain this oral vocabulary effect is as a bootstrapping mechanism that provides top-down support to scaffold partially decoded words until plausible meanings are achieved (e.g., Share, 1995).

The relationship between vocabulary and reading and between syntactic knowledge and reading depends partly on the readers' phase of reading development and the reading outcome used (Storch & Whitehurst, 2002). One longitudinal study of early literacy found a direct effect of a latent variable comprised of vocabulary and syntax in preschool on Kindergarten letter knowledge (Lonigan, Burgess, & Anthony, 2000). Sénéchal and LeFevre (2002) found that (a) preschoolers' vocabulary and listening comprehension directly

predicted word reading at the end of Grade 1 and indirectly predicted reading comprehension in Grade 3 and that (b) word reading at the end of Grade 1 predicted reading comprehension in Grade 3. Finally, a third longitudinal study found that the relationship between oral language and reading accuracy in Grades 1–2 and reading comprehension in Grades 3–4 was mediated by code-related skills such as letter knowledge and phonological awareness (Storch & Whitehurst, 2002).

Not surprisingly, the relationship between oral language and reading tends to be stronger when reading comprehension measures are employed rather than word reading measures, presumably because reading comprehension requires the understanding of units of text larger than individual words (e.g., Muter et al., 2004; Scarborough, 2005; Share & Leikin, 2004; Storch & Whitehurst, 2002). For example, Cromley and Azevedo (2007) found a direct effect of vocabulary on reading comprehension in a study of 175 students in 9th grade, but they also found an indirect effect mediated by inference—presumably needed when comprehension was compromised by encountering unknown word meanings. One could also imagine the cognitive complexity of verbal material indirectly influencing the relation of oral language skills of vocabulary and syntax to reading comprehension (e.g., Scarborough, 2005).

In sum, there is a substantial amount of research on relations between phonological awareness and reading (see Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Much of this research privileges phonological awareness as a core variable in predicting reading outcomes (e.g., Stanovich, 1988; Shankweiler et al., 1992), but other research relegates it to a reciprocal role fairly early in reading development (Perfetti, Beck, Bell, & Hughes, 1987) and emphasizes the integration of phonological, orthographic, and semantic representations (e.g., Seidenberg & McClelland, 1989). There is much less research on relations among vocabulary, syntax, and reading, and results vary depending on the phase of reading development studied and the reading outcomes used.

The Simple View of Reading

The Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) states that reading is a product of word recognition and language comprehension. The Simple View is relevant to a discussion of relations among syntax, vocabulary, listening comprehension, phonological awareness, and comprehension in the primary grades because of the strong relations between phonological awareness and word recognition and the possibility that vocabulary, syntactic knowledge, and listening comprehension comprise the language comprehension construct.

Tunmer and Chapman (2012) recently tested the hypothesis that vocabulary makes an independent contribution to word recognition in the Simple View of Reading model. They gave tests of vocabulary, nonword reading, word recognition, and listening and reading comprehension to 122 7-year-old students. Through regression analyses they found that vocabulary made a unique contribution to reading comprehension beyond that made by word recognition and listening comprehension. Through structural equation modeling they found that the latent variable of language comprehension—consisting of vocabulary and listening

comprehension—related to reading comprehension directly and indirectly through the latent variable of word recognition. However, Wagner, Herrera, Spencer, and Quinn (2014) found that Tunmer and Chapman had misspecified their model by omitting a required covariance. When they reran the model with the correct specification, they not only found that the Simple View of Reading fit the data well, but they also found that the Simple View was equivalent to models that replaced the covariance with a direct effect from oral language to decoding as well as a direct effect from decoding to oral language. This evidence of reciprocity can only be untangled through longitudinal and intervention studies.

Other researchers have found that vocabulary accounts for more variability in reading comprehension than listening comprehension does. Protopapas, Sideridis, Mouzaki and Simos (2007) in a longitudinal study conducted on the island of Crete, found that decoding had a negligible effect on reading comprehension when vocabulary was taken into account. Similarly, in a longitudinal study of 2,143 Dutch children, Verhoeven and Van Leeuwe (2008) found that reading comprehension in Grade 1 was explained by decoding and listening comprehension but that earlier vocabulary predicted later reading comprehension, whereas earlier listening comprehension did not.

In a meta-analysis, Garcia and Cain (2014) examined whether three reader skills—vocabulary, decoding, and listening comprehension—moderated the relationship between decoding and reading comprehension. Only listening comprehension was a significant moderator of the relationship. The authors were not surprised that decoding was not a significant moderator because of its declining role as word recognition becomes fluent and efficient. However, the authors were surprised that vocabulary was not a significant moderator of the decoding-reading comprehension relation. They surmised that perhaps an independent effect of vocabulary on both decoding and reading comprehension might have reduced its strength as a moderator. Alternatively, they wondered whether the vocabulary measures themselves are to blame for not adequately capturing complex language (National Early Literacy Panel, 2008).

In summary, the relations between vocabulary and listening comprehension as they relate to decoding and reading comprehension are unclear. This lack of clarity may be due to how and when the constructs are measured during reading development.

The current study

The current study used latent variable modeling to investigate relations among syntax, vocabulary, listening comprehension, phonological awareness, decoding fluency, and comprehension in Kindergarten, Grade 1, and Grade 2. Comprehension was measured with a listening comprehension outcome in Kindergarten and a reading comprehension outcome in Grades 1 and 2. Specifically, we asked the following two sets of research questions, one set pertaining to Kindergarten scores and another set to Grades 1 and 2:

1. What is the factor structure of measures of phonological awareness, syntax, vocabulary, and listening comprehension in Kindergarten? How do these factors relate to comprehension?

2. What is the factor structure of measures of phonological awareness, decoding fluency, syntax, vocabulary, and listening comprehension in Grades 1 and 2? How do these factors relate to reading comprehension?

METHODS

Participants

All participating students were from the same large urban school district in the Southeast. The Kindergarten sample consisted of 218 students from the 2012–2013 school year, 51.4 % were female and 67.1 % participated in the free and reduced price lunch program. The racial/ethnic breakdown was: 38.5 % White; 23.9 % African American; 9.2 % Multi-racial; 9.6 % Other; 3.2 % Asian; 0.5 % Hispanic; and 0.5 % Pacific Islander.

The Grade 1 sample consisted of 372 students from the 2011–2012 school year, 46.5 % female and 64.2 % participated in the free and reduced price lunch program. The racial/ethnic breakdown was: 33.9 % Hispanic; 21.8 % White; 30.9 % African American; 2.7 % Multi-racial; 2.7 % Asian; and 0.8 % Pacific Islander.

The Grade 2 sample consisted of 273 students from the 2012–2013 school year, 45.1 % were female and 70.3 % participated in the free and reduced price lunch program. The racial/ethnic breakdown was: 31.9 % Hispanic; 30.8 % African American; 24.9 % White; 2.6 % Asian; 1.1 % Pacific Islander; 3.3 % Multi-racial; and 0.7 % Other.

Measures

During the fall of 2011 and 2012, parental consent was received for participation in this study. Research staff individually administered measures of phonological awareness, syntax, vocabulary, and listening comprehension to Grade 1 students in January of 2012 and to Kindergarten and Grade 2 students in January of 2013. Outcome measures were group-administered to Grade 1 students in May of 2012 and to Kindergarten and Grade 2 students in May of 2013.

Phonological awareness measures—Students' ability to blend and segment phonemes in words heard orally was measured by administering subtests from the Comprehension Test of Phonological Processing-2 (CTOPP-2; Wagner, Torgesen, Rashotte, & Pearson, 2012): In Kindergarten, Sound Matching, Blending Words, Elision were administered and in Grades 1 and 2, Elision and Phoneme Isolation were administered. Wagner et al. (2012) report acceptable reliabilities for these subtests, with average internal consistency measured by Cronbach's alpha exceeding 0.80 for each subtest.

Syntax measures—The Sentence Structure and Recalling Sentences subtests of the Clinical Evaluation of Language Fundamentals-4 (Semel, Wigg, & Secord, 2003) were administered in Kindergarten, Grade 1, and Grade 2. In the Sentence Structure subtest, the student points to a picture that illustrates the sentences spoken by the examiner. In the Recalling Sentences subtest, the student imitates sentences presented by the examiner. Semel et al. (2003) report that: (a) for students ages 5–8, Cronbach's alpha reliability coefficients

for the Sentence Structure subtest range between 0.62 and 0.77; (b) for Recalling Sentences, reliability ranges between 0.91 and 0.96 for this age group.

Vocabulary measures—Receptive and expressive vocabulary measures were administered in Kindergarten, Grade 1, and Grade 2. The receptive vocabulary measure was the Peabody Picture Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007), which requires that students point to the picture from a group of four pictures that best represents a word spoken by the examiner. Dunn and Dunn (2007) report satisfactory reliability for the PPVT4, with internal consistency as measured by Cronbach's alpha ranging from 0.93 to 0.97 and test-retest correlations as measured by Pearson's r ranging from 0.92 to 0.96 for the age group tested.

The expressive vocabulary measure was from the Florida Assessments for Instruction in Reading (FAIR; Florida Department of Education, 2009a, 2009b). In this measure the examiner shows the student a picture and asks the student to label objects, actions, or attributes and prompts the student in cases where an answer requires further precision. Item response theory precision estimates were reported in the technical manual to be 0.80 for 90 % of the Kindergarten—Grade 2 normative samples from Florida (Florida Department of Education, 2009a, 2009b).

Listening comprehension measure—Listening comprehension was measured in Kindergarten, Grade 1, and Grade 2 with two narrative passages from the FAIR (Florida Department of Education, 2009a, 2009b). The examiner read each passage to the student and then asked the student to respond to five comprehension questions. Reported reliabilities (Cronbach's alpha) for each grade were 0.52 in Kindergarten, 0.43 in Grade 1, and 0.55 in Grade 2 (Florida Department of Education, 2009a, 2009b). Low reliabilities can result in biased estimates in regression designs. However, the latent variable modeling design employed here allowed for the evaluation of the impact of reliability in the context of the second-order oral language factor, which included listening comprehension. Reliabilities for the second-order oral language factors were computed in the current sample based on the loadings and residual variances of 0.92 in Kindergarten, 0.96 in Grade 1, and 0.94 in Grade 2 (see "Results" section for details).

Decoding fluency measures—Decoding fluency was measured in Grades 1 and 2 by two forms (Forms A and B) of the Nonword and Sight Word Efficiency subtests of the Test of Word Reading Efficiency-2 (TOWRE-2; Torgesen, Wagner, & Rashotte, 2012). In this test, the examiner asks students to read nonwords and sight words aloud as quickly as possible within 45 s. Torgesen et al. (2012) report alternate-forms reliability coefficients ranging from $r = 0.93$ – 0.94 for Sight Word Efficiency and from $r = 0.86$ – 0.95 for Nonword Efficiency. Test-retest coefficients for the same form exceed $r = 0.90$, while the average test-retest coefficients for different forms of the subtests are $r = 0.87$ (Torgesen et al., 2012).

Comprehension outcome measures—Subtests from the Gates–MacGinitie Reading Test-4 (MacGinitie, MacGinitie, Maria, & Dreyer, 2000) were group-administered as outcome measures. In Kindergarten the Listening Comprehension subtest from the Level PR (primary) was administered in small groups of up to five students. In this task the examiner

reads a story to the students and asks them to mark under the picture that depicts what happened in the story. The Kuder–Richardson Formula 20 (K–R 20) reliability coefficient is 0.93 for the Listening Comprehension subtest (MacGinitie et al., 2000).

In Grades 1 and 2 the Reading Comprehension subtest of the Gates–MacGinitie Reading Test-4 was administered to groups of approximately 10–15 students at a time. This subtest requires students to read each part of the story quietly and then find the one picture in the row that goes with the story. Students fill in the circle under that picture. The K–R 20 reliability coefficient is 0.93 for first graders and 0.92 for second graders taking the Reading Comprehension subtest in the spring (MacGinitie et al., 2000).

Procedures

Planned missing data design—A planned missing data design was employed in the Kindergarten, Grade 1, and the Grade 2 samples to reduce the average amount of test time for study participants (Graham, Taylor, Olchowski, & Cumsille, 2006). Study measures were assigned to one of three forms. Forms were created to include at least one measure from each construct. For example, one measure of syntax (i.e., Sentence Structure) was included on one form and the other syntax measure (i.e., Recalling Sentences) was included on the second form. The third form included both measures of syntax. The number of measures included on each form varied by grade in the following way: In Kindergarten, of the 9 independent variables, Form A included 7, Form B included 4, and Form C included 8; in the Grade 1 sample, Form A included 7 of the 12 independent variables, Form B included 8, and Form C included 12; in Grade 2, of the 12 independent variables, Form A included 10, Form B included 3, and Form C included 12. The comprehension outcome measure was administered to a proportion of students in each of the three forms (34–41 % in Kindergarten, 75–79 % in Grade 1, and 51–57 % in Grade 2). Students were randomly assigned to receive one of the three forms of measures.

In addition to reducing testing time, planned missing data designs are advantageous because they allow the researcher to treat any missing data as missing completely at random (MCAR), in that missingness can be considered completely unrelated to the study variables (Enders, 2010). Little's (1998) Test of Missing Completely at Random (MCAR) demonstrated that all missing data were considered MCAR across all grades [Kindergarten $\chi^2(359) = 349.33$, $p = 0.63$, Grade 1 $\chi^2(74) = 71.93$, $p = 0.55$, and Grade 2 $\chi^2(93) = 101.69$, $p = 0.25$]. Full information maximum likelihood (FIML) was used to handle all missing data.

Students were individually administered the study measures in January each year and the outcome measures in May. Administration time ranged between 25 and 45 min for Forms A and B for each grade, and between 40 and 60 min for students completing Form C. Due to the duration of testing, students were given short breaks between assessments and, when needed, students completed the form over two sessions. Assessments within a form were administered to students in a variable order. After the end of testing, students were given a small token (e.g. sticker, stamp or pencil) to thank them for their hard work.

In the Kindergarten sample, approximately 32.6–34.4 % of data were missing across all independent variables, with the exception of the FAIR expressive vocabulary measure which had only 3.2 % missing data. In the Grade 1 sample, approximately 22.8–34.7 % for 12 of the 13 study measures and 6.2 % for PPVT-4 were missing data. In Grade 2, approximately 34.1–46.9 % of data were missing across all study measures, with the exception of the FAIR expressive vocabulary measure which had only 1.8 % missing data. All missing data was considered MCAR because of the planned missing data design and FIML was used for all analyses.

Analysis

The analyses were conducted in two stages. In the first stage, confirmatory factor analysis (CFA) was used to identify the measurement model that best explained the correlations among the observed variables. Subsequently, structural equation modeling (SEM) was used to evaluate the extent to which the latent factors identified by the CFA predicted comprehension (listening comprehension in Kindergarten and reading comprehension in Grades 1 and 2).

Several nested CFA models were estimated and compared for each grade to identify the best fitting measurement model. For each estimated measurement model, the outcome variable (i.e., listening comprehension in Kindergarten and reading comprehension in Grades 1 and 2) was modeled as a single indicator factor where the unstandardized error variance of the observed variable was constrained to be equal to $r^2(1 - q)$, where r^2 is the sample variance and q is the reliability of the measure. Modeling the outcome as a single indicator factor adjusts parameter estimates using the measurement error present in the observed variable (Brown, 2006).

Five measurement models were evaluated in Kindergarten: (1) a five-factor model with specific factors of listening comprehension, syntax, vocabulary, phonological awareness, and the comprehension outcome; (2) a four-factor model with measures from two of the three oral language factors (i.e., listening comprehension, syntax, or vocabulary) combined to reflect a single factor and the remaining oral language factor, phonological awareness, and the comprehension outcome reflecting specific factors; (3) a three-factor model with one oral language factor (represented by listening comprehension, syntax, and vocabulary measures combined) and specific factors of phonological awareness and the comprehension outcome; (4) a second-order factor model of the oral language and phonological awareness factors and the comprehension outcome as a specific factor; and (5) a two-factor model with a pre-reading skills factor (represented by listening comprehension, syntax, vocabulary, and phonological awareness measures) and the comprehension outcome factor.

Four measurement models were evaluated in Grades 1 and 2: (1) a six-factor model with specific factors of listening comprehension, syntax, vocabulary, phonological awareness, decoding fluency, and reading comprehension; (2) a five-factor model with measures from two of the three oral language factors (i.e., listening comprehension, syntax, or vocabulary) combined to reflect a single factor and the remaining oral language factor, phonological awareness, decoding fluency, and reading comprehension reflecting specific factors; (3) a four-factor model with one oral language factor (represented by listening comprehension,

syntax, and vocabulary measures combined) and specific factors of phonological awareness, decoding fluency, and reading comprehension; and (4) a second-order factor model of the oral language factors and specific factors of phonological awareness, decoding fluency, and reading comprehension.

Model fit was evaluated using multiple indices, including Chi square (χ^2), comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residuals (SRMR). RMSEA values below 0.08, CFI and TLI values 0.95, and SRMR values 0.05 are preferred for an excellent model fit (Hu & Bentler, 1999). Model comparisons for nested models used the χ^2 difference test. A significant χ^2 difference test indicates that the more constrained model (i.e., the model with more degrees of freedom) provides significantly worse fit to the data than the less constrained model (i.e., the model with fewer degrees of freedom). The model that was found to provide the most parsimonious and best fit to the data for each grade was then used in a structural equation model (SEM) to understand how the factors of oral language predicted comprehension (i.e., listening comprehension in Kindergarten and reading comprehension in Grades 1 and 2).

RESULTS

Kindergarten

Kindergarten sample statistics are presented in Table 1: pairwise correlations, means, standard deviations, minimums and maximums for all observed variables. All scores reported are raw scores except for the PPVT-4 where standard scores were used. Correlations were strongest within constructs but the strong correlation between Recalling Sentences and Elision is notable ($r = 0.60$, $p < 0.01$).

Five CFA models were estimated and compared to identify the measurement model that best explained the correlations among the observed variables in Kindergarten. In all models, the comprehension outcome was modeled as a single indicator factor by constraining the unstandardized error variance of the observed variable to be equal to $\sigma^2(1 - q)$, where σ^2 is the sample variance and q is the reliability of the measure ($\sigma^2 = 13.72$, $\rho = 0.93$, and $\sigma^2(1 - q) = 113.61$ for the Gates Listening Comprehension).

Model 1 estimated specific factors of listening comprehension, syntax, vocabulary, phonological awareness, and the comprehension outcome. Model fit statistics for model 1 demonstrated good model fit to the data: $\chi^2(26) = 35.42$, $p = 0.10$, RMSEA = 0.04, CFI = 0.98, TLI = 0.97, SRMR = 0.06. Model 2 estimated a four factor model with two distinct factors of oral language (i.e., listening comprehension and syntax combined and vocabulary) and specific factors of phonological awareness and comprehension. This model demonstrated significantly better fit to the data than model 1, $\chi^2(30) = 39.23$, $p = 0.12$, RMSEA = 0.04, CFI = 0.98, TLI = 0.98, SRMR = 0.06, $\chi^2 = 3.81$, $df = 4$, $p = 0.43$. Model 3 estimated a three-factor model with one oral language factor (represented by listening comprehension, syntax, and vocabulary measures combined) and specific factors of phonological awareness and the comprehension outcome. This model demonstrated a

significantly better fit to the data than Model 2, $\chi^2(33) = 44.86$, $p = 0.08$, RMSEA = 0.04, CFI = 0.98, TLI = 0.97, SRMR = 0.06, $\chi^2 = 5.68$, $df = 3$, $p = 0.13$.

The resulting correlation between the oral language factor and phonological awareness was $r = 0.89$, suggesting that multicollinearity among the factors may be an issue. A second-order factor of oral language and phonological awareness (i.e., Model 4) and a one-factor model of oral language and phonological awareness (i.e., Model 5) were fit and statistically compared with Model 3 to determine which measurement model provided the best fit to the data.

Model 4 demonstrated equivalent model fit to Model 3, $\chi^2(33) = 44.86$, $p = 0.08$, RMSEA = 0.04, CFI = 0.98, TLI = 0.97, SRMR = 0.06. Model 5 demonstrated significantly worse model fit to Models 3 and 4, $\chi^2(35) = 51.38$, $p = 0.04$, RMSEA = 0.05, CFI = 0.97, TLI = 0.96, SRMR = 0.06, $\chi^2 = 6.52$, $df = 2$, $p = 0.04$. In Kindergarten, a second-order factor of oral language (which included measures of listening comprehension, syntax, and vocabulary) and phonological awareness provided the best fit to the data. Factor score reliabilities were computed using the standardized loadings and residual variances (Raykov, 1997) as 0.88 for the listening comprehension, syntax, and vocabulary first-order factor (Fig. 1), 0.72 for the phonological awareness factor, 0.92 for the second-order factor of language and phonological awareness, and 0.92 for the comprehension factor.

The second-order factor of oral language and phonological awareness was then used in a SEM model to investigate its ability to predict the comprehension factor. The final SEM model (shown in Fig. 1) demonstrated excellent fit to the data, $\chi^2(33) = 44.86$, $p = 0.08$, RMSEA = 0.04, CFI = 0.98, TLI = 0.97, SRMR = 0.06. The second-order oral language and phonological awareness factor (LP) significantly predicted comprehension ($\beta = 0.54$, $p < 0.001$) and accounted for 30 % of the variance in comprehension.

Grades 1 and 2

Pairwise correlations, means, SDs, minimums, and maximums for all observed measures are presented in Table 2 for Grade 1 and Table 3 for Grade 2. All scores are raw scores except for the Gates–MacGinitie which is Rasch based and PPVT-4 where standard scores are reported. The pattern of correlations within each grade was strongest within constructs. In Grade 1, the correlation between Gates–MacGinitie Reading Comprehension and CELF-4 Recalling Sentences ($r = 0.61$, $p < 0.01$), and between reading comprehension and the sight word forms of TOWRE-2 ($r = 0.65$ and 0.66 , $p < 0.01$) were also high. In Grade 2, the strongest correlation across constructs was the association between PPVT-4 vocabulary and the two syntax measures (CELF Sentence Structure and Recalling Sentences), $r = 0.61$, $p < 0.01$.

Four CFA models were estimated and compared to determine the structure of the oral language measures in Grade 1. In all models, the comprehension outcome was modeled as a single indicator factor by constraining the unstandardized error variance of the observed variable to be equal to $\sigma^2(1 - \rho)$, where σ^2 is the sample variance and ρ is the reliability of the measure ($\sigma^2 = 1,610.60$, $\rho = 0.93$, and $\sigma^2(1 - \rho) = 112.74$ for Grade 1 and $\sigma^2 = 1,420.15$, $\rho = 0.92$, and $\sigma^2(1 - \rho) = 113.61$ for Grade 2).

Model 1 estimated six distinct factors of listening comprehension, syntax, vocabulary, phonological awareness, decoding fluency, and reading comprehension and three distinct factors of oral language (i.e., listening comprehension, syntax, and vocabulary). Model fit statistics for Model 1 demonstrated adequate model fit to the data for both grades, $\chi^2(49) = 56.62$, $p = 0.21$, RMSEA = 0.02, CFI = 1.00, TLI = 1.00, SRMR = 0.03 in Grade 1 and $\chi^2(49) = 89.62$, $p < 0.001$, RMSEA = 0.06, CFI = 0.98, TLI = 0.96, SRMR = 0.05 in Grade 2. Model 2 estimated a five-factor model with two distinct factors of oral language (i.e., listening comprehension and syntax combined and vocabulary) and specific factors of phonological awareness, decoding fluency, and comprehension. Model 2 demonstrated significantly worse fit to the data than Model 1 in grade 1, $\chi^2(54) = 70.43$, $p = 0.07$, RMSEA = 0.03, CFI = 0.99, TLI = 0.99, SRMR = 0.03, $\chi^2 = 13.81$, $df = 5$, $p = 0.02$. Conversely, Model 2 resulted in a significantly better fit to the data than Model 1 in Grade 2, $\chi^2(54) = 95.68$, $p < 0.001$, RMSEA = 0.05, CFI = 0.97, TLI = 0.96, SRMR = 0.06, $\chi^2 = 6.06$, $df = 5$, $p = 0.30$.

Given that the results for Grade 1 suggest that the factors of oral language were best represented as three distinct factors, Model 3 for Grade 1 estimated a second-order factor of oral language and three distinct factors of phonological awareness, decoding fluency, and comprehension. Model 3 for Grade 1 demonstrated adequate model fit, $\chi^2(56) = 67.96$, $p = 0.13$, RMSEA = 0.02, CFI = 1.00, TLI = 0.99, SRMR = 0.03 and fit significantly better than Model 1, $\chi^2 = 11.34$, $df = 7$, $p = 0.12$. In Model 3, the second-order factor of oral language and phonological awareness was strongly related ($r = 0.81$); therefore, an additional CFA model (i.e., Model 4) was tested for Grade 1. Model 4 estimated a second-order factor that included the three oral language factors and phonological awareness, as well as decoding fluency and comprehension as distinct factors. Model 4 demonstrated significantly worse fit to the data than Model 3, $\chi^2(58) = 125.90$, $p < 0.001$, RMSEA = 0.06, CFI = 0.98, TLI = 0.97, SRMR = 0.09, $\chi^2 = 57.94$, $df = 2$, $p < 0.001$. Therefore, Model 3 was chosen as the best fitting model for Grade 1. Factor score reliabilities for these factors were estimated as 0.67 for the listening comprehension first-order factor, 0.83 for the syntax first-order factor, 0.83 for the vocabulary first-order factor, 0.96 for the oral language second-order factor, 0.96 for the decoding fluency factor, 0.71 for the phonological awareness factor, and 0.93 for the reading comprehension factor.

For Grade 2, Model 3 estimated a four-factor model with one oral language factor (represented by listening comprehension, syntax, and vocabulary measures combined) and specific factors of phonological awareness, decoding fluency, and comprehension. Model 3 demonstrated significantly worse fit to the data than Model 2, $\chi^2(58) = 108.19$, $p < 0.001$, RMSEA = 0.06, CFI = 0.97, TLI = 0.96, SRMR = 0.06, $\chi^2 = 12.51$, $df = 4$, $p = 0.01$. Model 4 estimated a second-order factor of oral language (i.e., listening comprehension and syntax combined and vocabulary) and specific factors of phonological awareness, decoding fluency, and comprehension. Model 4 demonstrated a significantly better fit to the data than Model 3, $\chi^2(56) = 98.15$, $p < 0.001$, RMSEA = 0.05, CFI = 0.97, TLI = 0.96, SRMR = 0.06, $\chi^2 = 2.47$, $df = 2$, $p = 0.29$. Therefore, Model 4 was chosen as the best fitting model for Grade 2. Factor score reliabilities for these factors were estimated as 0.79 for the listening comprehension/syntax first-order factor, 0.80 for the vocabulary first-order factor,

0.94 for the oral language second-order factor, 0.95 for the decoding fluency factor, 0.66 for the phonological awareness factor, and 0.92 for the reading comprehension factor.

The second-order oral language factor of listening comprehension, syntax, and vocabulary for Grade 1 was then used in a SEM model to investigate its ability to predict comprehension, after controlling for phonological awareness and decoding fluency. The final SEM model for Grade 1 (shown in Fig. 2) demonstrated adequate fit to the data, $\chi^2(56) = 70.25$, $p = 0.10$, RMSEA = 0.03, CFI = 1.00, TLI = 0.99, SRMR = 0.03. The second-order oral language factor significantly predicted reading comprehension ($\beta = 0.67$, $p < 0.05$), as did decoding fluency ($\beta = 0.66$, $p < 0.05$), whereas phonological awareness did not ($\beta = -0.31$, $p = 0.54$). Together these factors accounted for roughly 70 % of the variance in reading comprehension. In addition, oral language correlated significantly with decoding fluency ($r = 0.43$, $p < 0.001$) and phonological awareness ($r = 0.80$, $p < 0.001$), and decoding fluency significantly correlated with phonological awareness ($r = 0.80$, $p < 0.001$).

For Grade 2, the second-order oral language factor of vocabulary and the combination of listening comprehension and syntax was then used in a SEM model to investigate its ability to predict comprehension after controlling for phonological awareness and decoding fluency. The final SEM model for Grade 2 (shown in Fig. 3) demonstrated adequate fit to the data, $\chi^2(56) = 98.15$, $p < 0.001$, RMSEA = 0.05, CFI = 0.97, TLI = 0.96, SRMR = 0.06. The second-order oral language factor significantly predicted reading comprehension ($\beta = 0.58$, $p < 0.001$), as did decoding fluency ($\beta = 0.51$, $p < 0.001$), whereas phonological awareness did not ($\beta = -0.19$, $p = 0.40$). Together these factors accounted for roughly 59 % of the variance in reading comprehension. In addition, oral language correlated significantly with decoding fluency ($r = 0.41$, $p < 0.001$) and phonological awareness ($r = 0.67$, $p < 0.001$), and decoding fluency significantly correlated with phonological awareness ($r = 0.74$, $p < 0.001$).

In sum, the second-order oral language and phonological awareness language factor that best fit the kindergarten data accounted for 30 % of the variance in comprehension for students in Kindergarten. In Grade 1, 70 % of the variance in reading comprehension was accounted for by factors of oral language (consisting of listening comprehension, syntax, and vocabulary), phonological awareness, and decoding fluency. Phonological awareness was no longer predictive of reading comprehension once oral language and decoding fluency were accounted for. Lastly, in Grade 2, 59 % of the variance in reading comprehension was explained by the oral language (consisting of listening comprehension and syntax combined and vocabulary), phonological awareness, and decoding fluency factors. Phonological awareness did not significantly predict comprehension over and above oral language and decoding fluency.

DISCUSSION

In this study we examined the factor structure of oral language and reading as they relate to comprehension outcomes in Kindergarten, Grade 1, and Grade 2. We conducted separate analyses for each grade because the samples varied by grade in the number of cohorts, in the demographics, and in the number of auxiliary variables used to inform imputation.

The structure of oral language and reading in relation to comprehension outcomes in Kindergarten

In Kindergarten a second-order oral language factor consisting of what was shared between measures of oral language (listening comprehension, syntax, and vocabulary) and phonological awareness was the best fitting model. It is notable that Kindergarten data from a listening comprehension measure based on explicit and implicit questions, receptive and expressive vocabulary measures, and productive and receptive syntax measures were a single latent factor that shared variance with phonological awareness. Typically, phonological awareness loads on print-related factors when they are present in the model for Kindergarten students (e.g., Storch & Whitehurst, 2002). Also, the latent variable modeling of oral language tasks in primary-grade students typically include vocabulary only (e.g., Storch & Whitehurst, 2002) or vocabulary and listening comprehension (Tunmer & Chapman, 2012). Thus, validating the strong inter-relatedness of multiple measures of listening comprehension, vocabulary, and syntax is significant, especially given that most studies looking at relations among oral language measures use less robust methodologies than structural equation modeling, such as multiple regression (e.g., Roth, Speece, & Cooper, 2002; Sénéchal & LeFevre, 2002), profile analysis (e.g., Vellutino, Scanlon, Small, & Fanuele, 2006), or cluster analysis (Speece, Roth, Cooper, & de la Paz, 1999).

Thirty percent of the variance in comprehension was explained by this second-order factor. The Gates–MacGinitie Listening Comprehension subtest requires students to select pictures that best depict parts of a story read by the examiner. Possibly more variance would have been explained with an individually administered narrative comprehension measure that tapped deeper vocabulary and syntactic knowledge (see Potocki & Ecalle, 2013).

The structure of oral language and reading in relation to comprehension outcomes in Grades 1 and 2

The outcome measure in Grades 1 and 2 was the Gates–MacGinitie Reading Comprehension subtest. As in Kindergarten, data from first and second grade listening comprehension, syntax, and vocabulary measures comprised the oral language factor. However, unlike Kindergarten, phonological awareness was a distinct factor from oral language in Grades 1 and 2. The Nonword and Sight Word Efficiency subtests from the TOWRE-2 comprised a decoding fluency factor. These three factors—oral language, phonological awareness, and decoding fluency—accounted for 70 % of the variance in reading comprehension. It is noteworthy that phonological awareness, which was highly related to the factors of oral language and of decoding fluency, was no longer predictive of reading comprehension when oral language and decoding were included.

The factor structure of the oral language measures in Grades 1 and 2 differed in important ways from the factor structure in Kindergarten. In Kindergarten, listening comprehension, syntax, and vocabulary were part of the same factor and joined phonological awareness in a second-order factor. In contrast, in Grade 1 the dimension of oral language was a second-order factor of listening comprehension, syntax, and vocabulary. In Grade 2, oral language consisted of vocabulary and what was shared between listening comprehension and syntax. The important message is that in Grades 1 and 2 the dimension of oral language was well

described by syntax, listening comprehension, and vocabulary and that this factor and the decoding fluency factor, although related to each other, separately and similarly predicted reading comprehension: In Grade 1, $\beta = 0.67$, $p < 0.05$, for oral language and $\beta = 0.66$, $p < 0.05$, for decoding fluency; and in Grade 2, $\beta = 0.58$, $p < 0.05$, for oral language and $\beta = 0.51$, $p < 0.05$, for decoding fluency.

These findings that decoding fluency and an oral language factor comprised of syntax, listening comprehension, and vocabulary predicted reading comprehension in Grades 1 and 2 stand in contrast to results from Schatschneider et al. (2004) and Storch and Whitehurst (2002), which found that print-related measures predicted reading outcomes in Grades 1 and 2 but not oral language measures. Storch and Whitehurst (2002) found that oral language measures did not become significant predictors of reading comprehension until students were above second grade. In contrast, the present findings are consistent with those of Catts et al. (1999) and Muter et al. (2004), both of which are longitudinal studies of children in the age five to seven range. Oral language in both studies included measures of syntax and vocabulary (and Catts et al. also included measures of narrative retell and comprehension). Both studies found that print-related skills predicted word reading outcomes but that reading comprehension outcomes were predicted by word recognition and oral language. Sénéchal and LeFevre (2002) also found in their 5-year longitudinal study that oral language skills in preschool predicted reading comprehension in Grade 3.

What explains the differences in findings regarding the predictive power of oral language in these early grades? A likely reason is the difference in the measures. The Schatschneider et al. (2004) study used the Woodcock–Johnson Passage Comprehension (Woodcock & Johnson, 1989) as its measure of reading comprehension and the PPVT as its vocabulary measure. Storch and Whitehurst (2002) used the reading comprehension subtest from the Stanford Achievement Test and the PPVT and CELF Sentence Structure subtest as the oral language measures. As Keenan, Betjemann, and Olson (2008) point out, reading comprehension tests vary in the extent to which they assess decoding and oral language comprehension. The Woodcock–Johnson Passage Comprehension assesses sentence comprehension with a cloze format and the Stanford reading comprehension subtest has relatively simple passages with a multiple-choice question format. In contrast, Catts et al. (1999) went beyond the Woodcock–Johnson tests to include the Gray Oral Reading Test (Wierdholt & Bryant, 1992), which has open-ended comprehension questions, and Muter et al. (2004) used the British Neale Analysis of Reading Abilities-II (Neale, 1997), which has a forced-choice true–false response format for its passages that requires inferencing beyond the word level. Sénéchal and LeFevre (2002) used the vocabulary and reading comprehension subtests of the Gates–MacGinitie Reading Test.

The reading comprehension subtest from the Gates–MacGinitie Reading Test was also used in the present study. It requires students to go beyond a word-level response by selecting the picture that best depicts the passage. Finally, the multiple measures of vocabulary and syntax that assess deeper expressive and receptive skills used in the current study and in Catts et al. and in Muter et al. and the listening comprehension used in the current study and in Sénéchal and LeFevre (2002) are likely explanations for the significant predictions of oral language to reading comprehension, as suggested by the National Early Literacy Panel

(2008). An important result in the present study is the finding that the reading comprehension subtest from the Gates–MacGinitie was predicted by both decoding fluency and oral language skills. In fact, one could argue that a reading comprehension measure should address oral language skills as well as decoding skills from the earliest grades if it is to be a valid measure of the construct across grades.

The Simple View of Reading Revisited

The results of this study in Grades 1 and 2 generally support the claim of the Simple View of Reading that decoding and oral language explain reading comprehension. Moreover, phonological awareness did not have a positive or significant association with reading comprehension in Grades 1 and 2 when oral language and decoding fluency were included in the model. In other words, no subgroup of readers was evident for whom phonological awareness was an important correlate of reading success as some have suggested (e.g., Shankweiler et al., 1992; Stanovich, 1988; Vellutino et al., 1996).

Results of the current study corroborated Tunmer and Chapman's (2012) finding with seven-year-olds that a latent variable of oral language directly related to reading comprehension. We did not examine whether oral language also related to reading comprehension indirectly through word recognition, opting instead to test how syntax might combine with listening comprehension and vocabulary to predict comprehension. Likewise, because of listening comprehension's important contribution to the oral language factor, we did not treat it as a separate predictor of reading comprehension or as a moderator of the decoding-reading comprehension relation, as Garcia and Cain (2014) did in their meta-analysis.

Limitations

Because the samples included in the current study were relatively high poverty (i.e., 64–70 % participation in the free and reduced price lunch program), results can only be generalized to similar populations of relatively high poverty students. It should be noted, however, that one of the key comparison studies to the current study—Storch and Whitehurst (2002)—also had a very high poverty sample because they selected their sample from Head Start prekindergarten classrooms. Moreover, results are potentially limited by methods variance in that both syntax measures were from the CELF-4 and comprehension outcomes were solely from the Gates–MacGinitie Reading Test, and, as pointed out earlier, the skills tapped by the reading comprehension test do matter (Keenan et al., 2008). Further, the use of single-item indicators to estimate latent factor scores assumes a user-specified level of reliability in addition to the sample variance. The results are limited to the extent that sample variability and the assumed reliability of scores map onto the estimated factor. Finally, as stated above, we chose to focus our analyses on the dimensionality of oral language variables and the extent to which the resulting factors predicted reading comprehension rather than treating them separately as mediators and moderators of the decoding-reading comprehension relation.

CONCLUSIONS

This study examined the structure of oral language measures as they predicted listening comprehension in Kindergarten and, along with decoding fluency, predicted reading comprehension in Grades 1 and 2. The factor structure of oral language measures differed in Kindergarten compared to Grades 1 and 2. In Kindergarten, listening comprehension, syntax, and vocabulary were part of the same factor and shared variance with phonological awareness to form a second-order factor. In contrast, oral language was a second-order factor of listening comprehension, syntax, and vocabulary in Grade 1 and a combination of vocabulary and what was shared between syntax and listening comprehension in Grade 2. Significantly, the second-order oral language factors in Grades 1 and 2 and the decoding fluency factor, although related to each other, separately and similarly predicted reading comprehension. These findings send the important message that *both* oral language and decoding fluency skills are vital to fostering reading for understanding in the early grades.

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Fig. 1.

Standardized parameter estimates for the Kindergarten structural equation model. Oral language consists of estimates from the FAIR listening comprehension passage 1 and 2, CELF-4 Recalling Sentences and Sentence Structure subtests, and vocabulary subtests from the PPVT-4 and FAIR. Phonological awareness consists of estimates from the CTOPP-2 Elision, Sound Matching, and Blending Words subtests. The second-order factor of the combined oral language and phonological awareness factors (Lang/PA) predicts to the comprehension factor that includes the Listening Comprehension subtest from the Gates–MacGinitie. *** $p < 0.001$

Fig. 2.

Standardized parameter estimates for the Grade 1 structural equation model. The second-order factor of oral language consists of estimates from the latent variables of listening comprehension (from FAIR listening comprehension passages 1 and 2), syntax (from the CELF-4 Recalling Sentences and Sentence Structure subtests), and vocabulary (from PPVT-4 and FAIR). The factor of decoding fluency consists of estimates from the TOWRE (Sight Word Efficiency) forms A and B and from the Nonword (NW) forms A and B. The phonological awareness latent variable consists of estimates from the Elision and Phoneme Isolation subtests from the CTOPP-2. These factors predict the reading comprehension factor that consists of the Reading Comprehension subtest from the Gates–MacGinitie. *** $p < 0.001$; * $p < 0.05$

Fig. 3.

Standardized parameter estimates for the Grade 2 structural equation model. The second-order factor of oral language consists of estimates from the latent variables of listening comprehension and syntax combined (from the FAIR listening comprehension passage 1 and 2 and the CELF-4 Recalling Sentences and Sentence Structure subtests), and vocabulary (from PPVT-4 and FAIR). The factor of decoding fluency consists of estimates from the TOWRE (Sight Word Efficiency) forms A and B and from the Nonword (NW) forms A and B. The phonological awareness factor consists of estimates from the Elision and Phoneme Isolation subtests from the CTOPP-2. These factors predict the reading comprehension factor that consists of the Reading Comprehension subtest from the Gates–MacGinitie. *** $p < 0.001$

Table 1

Kindergarten pairwise correlations, means, SDs, minimum, and maximum for all observed measures

	1	2	3	4	5	6	7	8	9	10
1. Listening comprehension — Gates-MacGinitie-4	1									
N	79									
2. Sentence structure — CELF-4	0.41**	1								
N	54	147								
3. Recalling sentences — CELF-4	0.43**	0.61**	1							
N	54	74	144							
4. Vocabulary — PPVT-4	0.36**	0.66**	0.63**	1						
N	54	147	74	147						
5. FAIR vocabulary	0.48**	0.54**	0.56**	0.63**	1					
N	77	142	140	142	211					
6. FAIR listening comprehension passage 1	0.30*	0.57**	0.47**	0.54**	0.43**	1				
N	54	146	74	146	142	146				
7. FAIR listening comprehension passage 2	0.43**	0.47**	0.51**	0.51**	0.46**	0.48**	1			
N	54	146	74	146	142	146	146			
8. Elision — CTOPP-2	0.36**	0.58**	0.60**	0.47**	0.49**	0.38**	0.50**	1		
N	53	76	143	76	140	76	76	145		
9. Sound matching — CTOPP-2	0.41**	0.17**	0.38**	0.40**	0.31**	0.30**	0.25**	0.57**	1	
N	53	143	7	143	138	142	142	72	143	
10. Blending words — CTOPP-2	0.40**	0.44**	0.37**	0.53**	0.41**	0.35**	0.47**	0.41**	0.38**	1
N	50	78	75	78	143	77	77	76	74	147
Mean	12.28	18.35	28.98	101.76	10.32	3.27	3.48	10.81	13.47	15.67
SD	3.61	4.34	12.88	14.04	4.08	1.53	1.22	5.73	6.83	7.37
Minimum	5.00	4.00	0	65	0	0	0	0	0	0
Maximum	18.00	26.00	65.00	137.00	24.00	5.00	5.00	27.00	26.00	31.00

CELF-4 Clinical Evaluation of Language Fundamentals, 4th ed., PPVT-4 Peabody Picture Vocabulary Test, 4th ed., FAIR Florida Assessments for Instruction in Reading, CTOPP-2 Comprehensive Test of Phonological Processing, 2nd ed.

**
p < 0.01;

50.0 > *d'*
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Table 2

Grade 1 correlations, means, SDs, minimum, and maximum for measures

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Reading comprehension — Gates-MacGinitie	1												
N	287												
2. FAIR listening comp passage 1	0.42**	1											
N	191	249											
3. FAIR Listening comp passage 2	0.37**	0.49**	1										
N	191	249	249										
4. Sentence structure — CELF-4	0.52**	0.59**	0.55**	1									
N	190	248	248	248									
5. Recalling sentences — CELF-4	0.60**	0.43**	0.52**	0.65**	1								
N	190	122	122	122	243								
6. Vocabulary — PPVT-4	0.60**	0.50**	0.46**	0.66**	0.76**	1							
N	192	249	249	248	123	250							
7. FAIR vocabulary	0.52**	0.46**	0.48**	0.57**	0.64**	0.70**	1						
N	279	231	231	230	230	232	349						
8. Phoneme isolation — CTOPP-2	0.46**	0.35**	0.38**	0.50**	0.49**	0.50**	0.43**	1					
N	188	121	249	121	238	122	225	238					
9. Elision — CTOPP-2	0.63**	0.36**	0.38**	0.56**	0.50**	0.55**	0.47**	0.56**	1				
N	192	249	122	248	126	249	235	121	253				
10. TOWRE sight word Form A	0.65**	0.31**	0.34**	0.39**	0.35**	0.41**	0.33**	0.46**	0.68**	1			
N	191	122	122	122	242	123	230	237	126	243			
11. TOWRE sight word Form B	0.67**	0.29**	0.35**	0.38**	0.33**	0.42**	0.32**	0.45**	0.69**	0.97**	1		
N	191	122	122	122	242	123	230	237	126	243	243		
12. TOWRE nonsense word Form A	0.58**	0.26**	0.22**	0.37**	0.30**	0.33**	0.24**	0.45**	0.65**	0.85**	0.84**	1	
N	191	122	122	122	242	123	230	237	126	243	243	243	
13. TOWRE nonsense word Form B	0.57**	0.29**	0.22*	0.39**	0.31**	0.33**	0.25**	0.46**	0.63**	0.84**	0.83**	0.95**	1
N	191	122	122	122	242	123	230	237	126	243	243	243	243

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	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	403.07	3.19	3.34	20.85	35.56	97.28	9.64	18.45	15.81	31.83	31.34	14.02	13.16
SD	40.67	127	1.28	4.07	14.71	14.88	4.24	8.25	7.72	16.74	16.97	9.36	9.37
Minimum	288.00	0	0	8	0	49	0	0	0	0	0	0	0
Maximum	512.00	5	5	26	75	149	24	32	34	73	70	49.00	48.00

CELF-4, Clinical Evaluation of Language Fundamentals; PPVT-4, Peabody Picture Vocabulary Test; FAIR, Florida Assessments for Instruction in Reading; CTOPP-2, Comprehensive Test of Phonological Processing; TOWRE-2, Test of Word Reading Efficiency

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 $p < 0.01$;
*
 $p < 0.05$

Table 3

Grade 2 correlations, means, SDs, minimum, and maximum for measures

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Reading comprehension — Gates-MacGinitie	1												
N	145												
2. Sentence structure — CELF-4	0.46**	1											
N	97	179											
3. Recalling sentences — CELF-4	0.57**	0.59**	1										
N	95	84	176										
4. Vocabulary — PPVT-4	0.55**	0.61**	0.61**	1									
N	95	176	82	177									
5. FAIR vocabulary	0.46**	0.46**	0.59**	0.64**	1								
N	141	179	171	177	268								
6. FAIR Listening comp passage 1	0.24*	0.37**	0.50**	0.42**	0.38**	1							
N	97	179	84	177	180	180							
7. FAIR Listening comp passage 2	0.37**	0.54**	0.48**	0.42**	0.41**	0.38**	1						
N	97	179	84	177	180	180	180						
8. Elision — CTOPP-2	0.40**	0.34**	0.42**	0.45**	0.35**	0.20**	0.19*	1					
N	97	178	84	176	179	179	179	179					
9. Phoneme isolation — CTOPP-2	0.31**	0.30**	0.37**	0.37**	0.28**	0.28**	.038**	0.47**	1				
N	95	84	176	82	171	84	84	84	176				
10. TOWRE sight word Form A	0.57**	0.23**	0.39**	0.35**	0.30**	0.15*	0.17*	0.54**	0.28**	1			
N	96	178	84	176	179	179	179	178	84	179			
11. TOWRE sight word Form B	0.56**	0.26**	0.38**	0.36**	0.27**	0.17**	0.19*	0.57**	0.36**	0.94**	1		
N	96	178	84	176	179	179	179	178	84	179	179		
12. TOWRE nonsense word Form A	0.48**	0.07	0.27*	0.31**	0.18*	0.08	0.07	0.58**	0.31**	0.83**	0.84**	1	
N	96	178	84	176	179	179	179	178	84	179	179	179	
13. TOWRE nonsense word Form B	0.49**	0.15*	0.31*	0.37**	0.24**	0.09	0.13	0.56**	0.32**	0.84**	0.83**	0.92**	1
N	96	178	84	176	179	179	179	178	84	179	179	179	179

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	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	433.77	23.28	45.86	100.44	11.06	3.84	4.24	21.59	22.93	55.02	54.37	26.26	24.74
SD	37.20	2.84	14.26	14.90	3.55	1.06	0.98	6.80	6.77	12.47	12.29	10.72	11.76
Minimum	332.00	9.00	8.00	49.00	0	0	0	0	0	12.00	21.00	4.00	1.00
Maximum	540.00	26.00	80.00	141.00	22.00	5.00	5.00	34.00	32.00	81.00	78.00	53.00	50.00

Gates–MacGinitie–4, Gates–MacGinitie Reading Test, 4th ed.; CELF–4, Clinical Evaluation of Language Fundamentals, 4th ed.; PPVT–4, Peabody Picture Vocabulary Test, 4th ed.; FAIR, Florida Assessments for Instruction in Reading; CTOPP–2, Comprehensive Test of Phonological Processing, 2nd ed.; TOWRE–2 Test of Word Reading Efficiency, 2nd ed.

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 $p < 0.01$;

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 $p < 0.05$