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Growth in Reading Comprehension and Verbal Ability From Grades 1 Through 9

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Abstract

We systematically assessed the relationships between growth of four components of verbal ability—Information, Similarities, Vocabulary, and Comprehension subtests of the Wechsler Intelligence Scale–Revised—and longitudinal growth from Grades 1 to 9 of the Woodcock–Johnson Psycho-Educational Battery Passage Comprehension subtest while controlling for Word Identification and Word Attack, using multilevel growth models on a sample of 414 children. Growth was assessed over all grades (1-9), and separately for early grades (1-5) and later grades (5-9). Over all grades, growth in Word Identification had a substantial standardized loading to Passage Comprehension, and all four verbal abilities had smaller, but significant standardized loadings to Passage Comprehension ($p < .05$), with Information and Vocabulary having slightly higher loadings than Similarities and Comprehension. For early grades, results were similar to the overall results, with the exception of Vocabulary, which had a nonsignificant loading to Passage Comprehension. For later grades, Word Identification again had the largest, but substantially smaller standardized loading on Passage Comprehension and standardized loadings of all four verbal abilities were statistically significant with Vocabulary and Wechsler Intelligence Scale for Children–Revised (WISC-R) Comprehension having appreciably higher loadings than in the previous analyses. Conversation- and interaction-based intervention and instruction in oral language in general, and vocabulary in particular throughout early childhood and continuing throughout the school years, combined with evidence-based instruction that systematically develops the skills of phonologic awareness, decoding, word reading, fluency, and comprehension in school, may provide a pathway to reducing the achievement gap in reading.

Keywords

reading comprehension, verbal ability, vocabulary, multilevel models, longitudinal studies

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Although phonological processes are central to learning to read, other language-based factors, such as morphology, orthography, vocabulary, and verbal ability, contribute to the development of reading (Perfetti, 2011). Thus, just as phonemic awareness and phonics are underlying pillars of growth in decoding and word reading that lead to reading fluency, vocabulary and verbal ability have repeatedly been identified as contributors to reading comprehension, and educators have long known that reading instruction must address more than teaching phonological awareness and phonics. Although the National Reading Panel (2000) identified five components of reading instruction, phonemic awareness, phonics, fluency, vocabulary, and text comprehension, the most appropriate combinations of these components in instruction for readers of different ages and achievement levels are unknown.

Vocabulary as an important component of reading instruction has long been postulated (Thorndike, 1914) and evidence of its relationships to decoding, word reading, and comprehension throughout the developmental period has received renewed attention. Vocabulary has emerged as a predictor of reading comprehension after controlling for word reading and decoding, most recently in both cross-sectional (e.g., Braze, Tabor, Shankweiler, & Mencl, 2007; Ouellette & Beers, 2010; Tilstra, McMaster, Van den Broek, Kendeou, & Rapp, 2009) and longitudinal contexts (e.g., Verhoeven & Van Leeuwe, 2008; Wood, 2009) throughout various spans of the development of reading skills. Vocabulary also has been investigated as a component of three theoretical models of reading comprehension: the simple view of reading (SVR), the lexical quality hypothesis (LQH), and, more recently, the direct and inferential mediation (DIME) model of reading comprehension, which has been developed for reading in high school (Cromley & Azevedo, 2007) and beyond (Cromley, Snyder-Hogan, & Luciw-Dubas, 2010).

The SVR (Gough & Tunmer, 1986; Hoover & Gough, 1990) posits that reading comprehension is a product of decoding skill and listening comprehension. Decoding skill is assessed by word and pseudo-word reading and listening comprehension typically is assessed by the examinee's responses to passages of text perceived aurally rather than visually. The combination of decoding skills and listening comprehension has been shown to account for much of the reliable variance in reading comprehension. In contrast to the better-defined construct of decoding skills, listening comprehension is a composite of often unspecified skills ranging from elements of language comprehension and reasoning, to verbal or cognitive ability (Braze et al., 2016; Cain, 2015). Several recent studies have provided some empirical support for vocabulary to be included in the model as a separate direct or indirect contributor to reading comprehension (Braze et al., 2016; Braze et al., 2007; Cain, 2015; Fraser & Conti-Ramsden, 2008; Ouellette & Beers, 2010; Protopapas, Mouzaki, Sideridis, Kotsolakou, & Simos, 2013; Tilstra et al., 2009). Catts, Hogan, and Adlof (2005) found that the contribution of decoding is large relative to listening skill in predicting reading comprehension in young readers and that listening becomes the more substantial predictor over time. Evidence from meta-analysis (Garcia & Cain, 2014) and a recent study (Cain, 2015) indicate that listening comprehension begins to overtake decoding in the prediction of reading comprehension as early as Grade 2, although the timing of the transition may vary with the measures used and methods of statistical analysis (Cain & Oakhill, 2006; Cutting & Scarborough, 2006; Garcia & Cain, 2014; Keenan, Betjemann, & Olson, 2008).

The LQH (Perfetti, 2007; Perfetti & Stafura, 2014) posits that accurate and fluent reading require that the reader's lexicon be highly interconnected with word forms (phonology, orthography) and meanings (semantic representations), an interpretation consistent with converging neurobiological evidence (Price & Devlin, 2011). Measures of vocabulary depth, rather than breadth, may be useful in more precisely understanding the contribution of vocabulary as indicators of lexical quality (Cain & Oakhill, 2014).

The DIME model extends the SVR by describing the relations among cognitive processes that contribute to reading comprehension in high school students. In a path analysis of 177 ninth-grade science students, Cromley and Azevedo (2007) demonstrated that the combination of

content-specific background knowledge and vocabulary measures made direct contributions to reading comprehension and additional indirect mediation through inference-making to comprehension. They found that the content-specific vocabulary and background knowledge along with inference-making had the largest effects on comprehension and word reading, and comprehension strategies had smaller effects on comprehension. Cromley et al. (2010) refined and extended the DIME model with a sample of 737 college biology majors in their first-semester biology course. Results of structural equation models indicated that a modified DIME model was superior to the original DIME model. Vocabulary and domain-specific knowledge had significant indirect effects on comprehension through strategies and inference, and there were no direct effects for word reading or comprehension strategies on reading comprehension.

In other efforts to clarify the contribution of language to reading comprehension, several recent studies have found significant contributions made by a general oral language factor, typically a combination of vocabulary, syntax, and listening comprehension, to the prediction of reading comprehension in early schooling (e.g., Foorman, Herrera, Petscher, Mitchell, & Truckenmiller, 2015), in later grades (Foorman, Koon, Petscher, Mitchell, & Truckenmiller, 2015), and in adolescent students (Brimo, Apel, & Fountain, 2015).

Although vocabulary is a major contributor to Verbal IQ (VIQ) and is the single best predictor of Full-Scale IQ for the Wechsler Intelligence Scale for Children–Revised (WISC-R), other aspects of verbal ability, measured with the WISC-R by the Information, Similarities, and Comprehension subtests, broaden the construct to include retrieval of factual knowledge, reasoning skills, and social and cultural awareness, respectively (Sattler, 1990). These components of verbal ability extend beyond the core of vocabulary depth assessed by the Vocabulary subtest. The Similarities and Information subtests have been used occasionally as predictors of reading comprehension (e.g., Cain, Oakhill, & Bryant, 2004; Tighe, Wagner, & Schatschneider, 2015). We focus on the predictive utility of all four subtests of WISC-R verbal ability identified through factor analysis (Kaufman, 1975), rather than the composite measure of VIQ. The purpose of the current study is to describe the relationships among growth in word reading, decoding skill, and the four components of verbal ability to growth in reading comprehension longitudinally from Grades 1 to 9. Specifically, given the evidence for the change over time in the relative contribution of listening skills relative to decoding skills in predicting reading comprehension in the SVR, we hypothesized that growth in Information, Similarities, Vocabulary, and Comprehension would each contribute beyond growth in word reading and decoding skill to growth in reading comprehension from Grades 1 to 9. Furthermore, we hypothesized that the relative contributions of the components of verbal ability would vary when the growth models span Grades 1 to 5 as compared with Grades 5 to 9 with vocabulary making a more substantial contribution to reading comprehension in the later grades.

Method

Participants

We report findings from a unique longitudinal study, the Connectigut Longitudinal Study, a sample survey of 414 schoolchildren representative of those children entering public kindergarten in 1983. All participants were primary English speakers. This cohort, assembled from a two-stage probability sample survey, has been followed longitudinally from school entry into early adulthood with the purpose of studying the development of reading, learning, and attention (Ferrer et al., 2007; Ferrer, Shaywitz, Holahan, Marchione, & Shaywitz, 2010; Ferrer et al., 2015; B. Shaywitz et al., 1995; S. E. Shaywitz et al., 1999).

The sample was categorized into four groups of readers: good readers (n = 178), midrange readers (n = 139), compensated readers (n = 31), and persistently poor readers (n = 66). The

groups were formed using the Reading Cluster score (the composite of all three reading subtests) from the Woodcock–Johnson Psycho-Educational Test Battery (WJ; Woodcock & Johnson, 1977) and the WISC-R (Wechsler, 1981) Full Scale IQ score. At each grade, poor readers were identified as children with an observed WJ Reading Cluster age standard score (composite reading score) 1.5 standard errors below the score predicted from their Full Scale IQ (discrepancy definition) or with a Reading Cluster score below 90 (low-achievement definition). Both of these definitions validly identify children as poor readers, and there is little evidence of differences between subgroups of children formed with one criterion versus the other (S. E. Shaywitz et al., 2003). Good readers did not meet criteria for poor reading at any of the status assessments and had reading age standard scores >94 (above the 40th percentile) in all of Grades 2 to 10. Compensated readers met criteria for poor reading in Grade 2 or Grade 4 but not in Grades 9 or 10. Persistently, poor readers met criteria for poor reading at both status assessments. Midrange readers attained Reading Cluster scores always >90, but were ≤94 for at least one assessment from Grades 2 to 10.

Measures

WJ subtests, Letter-Word Identification, Word Attack, and Passage Comprehension part scores (individual subtest components of the Rasch model W score of the Reading Cluster) measured the three reading components of interest. For detailed information regarding the development and the WJ tests, the W score scale, and the Rasch model, see Woodcock (1977). Information, Similarities, Vocabulary, and Comprehension subtest raw scores of the WISC-R assessed verbal ability. Reading measures were administered annually from Grades 1 to 12; the WISC-R was administered in Grades 1, 3, 5, 7, and 9. Published reliabilities for the WJ subtests range from r = .80 to .92 for Passage Comprehension, r = .90 to .97 for Letter-Word Identification, and r = .91 to .94 for Word Attack across Grades 1 to 8 (Woodcock, 1977). The average reliabilities of the four WISC-R Subtests range from r = .77 for Similarities to .86 for Vocabulary (Sattler, 1990).

Analytic Procedures

A multilevel regression analysis model was designed to measure growth in reading comprehension in readers of differing levels of achievement and to yield estimates of the relative contributions of two reading components (WJ Letter-Word Identification and Word Attack) and measures of verbal ability (WISC-R Information, Similarities, Vocabulary, and Comprehension subtests) on growth in WJ Passage Comprehension. Estimating these growth trajectories included time-invariant variables: dummy variables defining reading subgroups, time-varying weights to measure linear and quadratic growth parameters, and Growth Parameter × Reader Group interactions. Time-varying covariates (Word Attack, Letter-Word Identification, Information, Similarities, Vocabulary, and Comprehension) assessed the relations between the covariates and Passage Comprehension. Changes in means of Passage Comprehension for the reading subgroups and their growth parameters were estimated as fixed effects and changes in individual student trajectories were estimated as random effects (Rabe-Hesketh & Skrondal, 2008; Raudenbush & Bryk, 2002). The growth curve parameters are regression weights based on a mixed effects hierarchical model estimated by STATA (StataCorp, 2013) software program XTMIXED (StataCorp, 2007). Maximum likelihood using expectation–maximization (EM) estimation with an unspecified random effects covariance matrix was used in all analyses.

All 414 children had at least two longitudinal data points spanning Grades 1, 3, 5, 7, and 9. We purposely alternated grades to allow sufficient time between reading assessments to demonstrate meaningful growth yet have sufficient data points to define reliable growth curves within a multilevel mixed model approach. The grade variable and linear and quadratic growth parameters

were coded using normalized coefficients and normalized orthogonal polynomials, respectively. Comparisons of the regression weights representing intercepts associated with the remaining groups are contrasts of their average reading performance over the assessment times included in the model and that of the persistently poor readers group. The random component of the intercept estimates the average variation between individuals on their Passage Comprehension scores averaged across all grades. The fixed effect regression weight associated with grade is the average linear growth of persistently poor readers (the contrast group) on the dependent variable, Passage Comprehension. The random component of grade estimates the variation between individuals with respect to linear growth rates.

Three pairs of two-level multilevel regression models (participants at Level 2 and the repeated assessments at Level 1) were completed with Passage Comprehension part (W) scores as the dependent variable. The first model in each pair is a growth model (containing no covariates) and included the following parameters: linear effects of grade representing the longitudinal time points as both a fixed and random effect, a quadratic component of grade, dummy variables indicating membership in the three reading groups, and the interactions of group with both the linear and quadratic effects of grade. The three reading groups are contrasted to the persistently poor readers. The second model in each pair included part (W) scores of reading measures (Letter-Word ID, and Word Attack) and raw scores for the four verbal abilities (Information, Similarities, Vocabulary, and Comprehension) as time-varying covariates. Incremental reductions in the fixed main and interaction effects may be compared across models to assess the relative contributions yielded by the time-varying control variables relative to the growth model. Similarly, reductions in the variance of the random effects may be compared across models to assess effects of the time-varying covariates on the individual slopes and average levels or intercepts relative to the growth model. The intra-class correlations (ICC) and Bayesian Information Criteria (BIC) assess proportions of within-participant variance remaining unaccounted for and the model fit, respectively, in each analysis. Missing data were estimated for a maximum of 2.5% of data points. One participant was excluded in the last two analyses because of missing data. The number and percentage of participants and data points are provided with the results for each model. Models 1 and 2 include data from Grades 1 to 9; Models 3 and 4 include data from Grades 1 to 5; and Models 5 and 6 include data from Grades 5 to 9. Splitting the data into two grade spans enables detection of changes in the relative contributions of the time-varying covariates across grades.

Results

The estimated model parameters (in columns) and the three pairs of two multilevel regression growth curve models of Passage Comprehension are presented in Table 1. The fixed effects regression weights appear in the upper portion and the random effects appear in the lower portion of Table 1. The constant reported in the Growth Model 1 for Grades 1 to 9 (160.28) is the adjusted mean Passage Comprehension score of the persistently poor readers averaged across the five occasions. For the grade main effects, the average linear growth rate in Passage Comprehension of the persistently poor readers from Grades 1 to 9 was 22.04. The quadratic component of the persistently poor readers was −7.04. The linear growth rate was 3.13 times larger than the quadratic component. Both the linear and quadratic components were statistically significant. The negative sign associated with the quadratic term reflects the deceleration in the rate of Passage Comprehension growth for members of the persistently poor reading group as they progress through the grades in school. The three group main effects are the adjusted mean deviations, averaged across five time points, for each reading group contrasted to the persistently poor reading group: 5.08, 6.60, and 11.34 for the compensated, midrange, and good readers, respectively. All three groups differed significantly from the persistently poor readers, and the compensated readers had the smallest but still significant difference.

Table 1. Multilevel Regressions of Reading and Verbal Ability on Reading Comprehension Growth for Grades 1 to 9.

	Grades 1 to 9			Grades 1 to 5			Grades 5 to 9		
	Model 1	Model 2		Model 3	Model 4		Model 5	Model 6	
	Growth	Reading + verbal ability		Growth	Reading + verbal ability		Growth	Reading + verbal ability	
Parameter	Fixed effects								
Grades	Coefficient (*SE*)	Coefficient (*SE*)	Standard coefficient	Coefficient (*SE*)	Coefficient (*SE*)	Standard coefficient	Coefficient (*SE*)	Coefficient (*SE*)	Standard coefficient
Linear	22.04 (0.60)	4.58 (0.65)		15.34 (0.58)	3.14 (0.58)		5.27 (0.40)	1.69 (0.45)	
Quadratic	−7.04 (0.44)	−1.82 (0.43)		−3.33 (0.40)	−0.95* (0.40)		−0.74* (0.35)	−0.22 *ns* (0.36)	
Groups									
Compensated Readers	5.09 (0.80)	0.28 *ns* (0.46)		4.70 (0.90)	0.51 *ns* (0.50)		5.46 (0.82)	1.33* (0.57)	
Midrange Readers	6.60 (0.55)	0.14 *ns* (0.35)		7.14 (0.62)	0.66 *ns* (0.38)		5.84 (0.57)	1.22** (0.45)	
Good Readers	11.34 (0.53)	0.81* (0.40)		12.36 (0.60)	1.37* (0.45)		9.88 (0.54)	2.14 (0.53)	
Grade linear ×									
Compensated Readers	1.51 *ns* (1.06)	−0.75 *ns* (0.82)		0.74 *ns* (1.03)	−0.24 *ns* (0.82)		1.02 *ns* (0.70)	0.15 *ns* (0.74)	
Midrange Readers	−2.07** (0.73)	−2.29 (0.58)		−1.62* (0.71)	−1.06 *ns* (0.57)		−0.22 *ns* (0.49)	−0.82 *ns* (0.51)	
Good Readers	−4.08 (0.70)	−3.26 (0.56)		−3.83 (0.68)	−2.85 (0.56)		−0.04 *ns* (0.46)	−0.21 *ns* (0.49)	
Grade Quadratic ×									
Compensated Readers	0.27 *ns* (0.77)	0.19 *ns* (0.71)		−0.43 *ns* (0.70)	−0.30 *ns* (0.70)		0.77 *ns* (0.61)	0.86 *ns* (0.62)	
Midrange Readers	0.73 *ns* (0.53)	−0.04 *ns* (0.50)		−0.03 *ns* (0.48)	0.04 *ns* (0.48)		−0.04 *ns* (0.42)	−0.11 *ns* (0.43)	
Good Readers	2.52 (0.51)	1.75 (0.48)		0.87 *ns* (0.46)	0.29 *ns* (0.46)		0.24 *ns* (0.41)	0.21 *ns* (0.42)	
Time-varying covariates									
WJ Letter-Word ID		0.43 (0.02)	0.54		0.45 (0.02)	0.56		0.22 (0.03)	0.28
WJ Word Attack		0.14 (0.02)	0.12		0.13 (0.03)	0.12		0.09** (0.03)	0.08
WISC-R Information		0.14 (0.04)	0.08		0.17 (0.05)	0.10		0.14 (0.04)	0.08
WISC-R Similarities		0.07 (0.03)	0.04		0.08* (0.04)	0.05		0.09* (0.04)	0.05
WISC-R Vocabulary		0.07 (0.02)	0.08		0.04 *ns* (0.03)	0.04		0.12 (0.02)	0.13
WISC-R Comprehension		0.06 (0.03)	0.04		0.08* (0.04)	0.05		0.14 (0.03)	0.09
Constant	160.28 (0.45)	65.002 (3.28)		154.07 (0.51)	61.74 (3.70)		167.59 (0.46)	105.19 (5.38)	

(continued)

Table 1. (continued)

	Random effects					
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
SD-slopes	3.31 (0.26)	1.87 (0.29)	3.46 (0.25)	1.92 (0.32)	1.55 (0.30)	1.74 (0.28)
SD-Constant	3.32 (0.14)	1.38 (0.11)	3.69 (0.16)	1.21 (0.18)	3.40 (0.15)	1.82 (0.13)
γ, *M*, and constant	−0.27 (0.08)	0.50 (0.16)	−0.52 (0.07)	0.03 (0.19)	0.16 (0.12)	0.26 (0.13)
SD (residual)	3.56 (0.07)	3.25 (0.07)	3.22 (0.11)	3.16 (0.11)	2.82 (0.10)	2.84 (0.10)
Wald chi-square	8,378.07	15,702.74	4,074.45	8,364.78	1,460.91	2,356.21
Log restricted likelihood	−5,977.25	−5,432.12	−3,670.11	−3,265.78	−3,402.67	−3,206.40
ICC	.47 (.02)	.15 (.02)	.57 (.03)	.13 (.04)	.59 (.03)	.29 (.04)
BIC	12,076.52	11,031.70	7,454.17	6,687.86	6,919.10	6,568.97
Number of parameters	11	17	11	17	11	17
N participants/percentage	414/100	414/100	414/100	414/100	413/99.76	413/99.76
N observations/percentage	2,050/99.03	2,022/97.68	1,239/99.76	1,217/97.99	1,224/98.55	1,211/97.50

Note. Unmarked coefficients are statistically significant $p < .001$. Other coefficients are significant as marked. Standard errors are in parentheses. WJ = Woodcock–Johnson; WISC-R = Wechsler Intelligence Scale for Children–Revised; ICC = Intra-Class Correlations; BIC = Bayesian Information Criteria.
*$p < .05$. **$p < .01$.

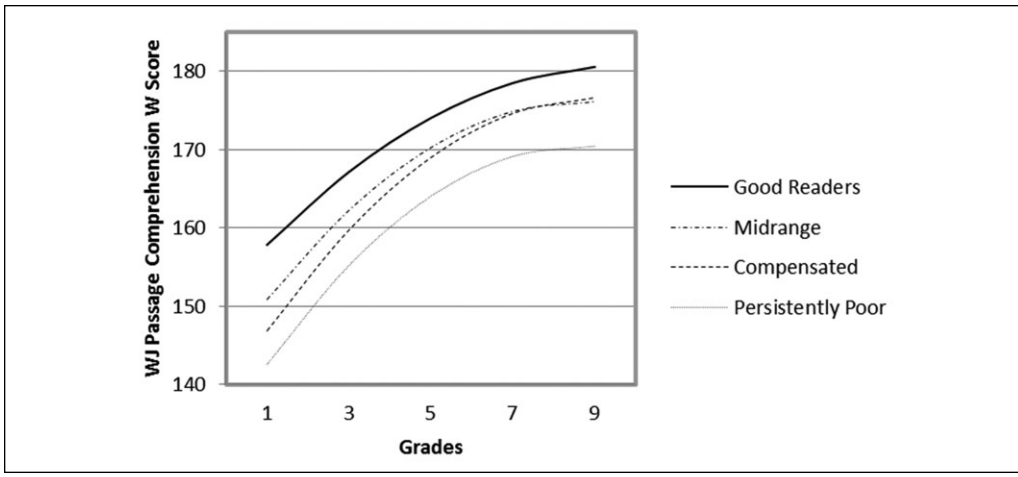

Figure 1. Woodcock–Johnson Passage Comprehension W (part) scores predicted for reading groups in the growth Multilevel Regression Model 1.

The Grade Linear × Reading Group interactions in Model 1 assessed the average linear growth in Passage Comprehension made by each reading group from Grades 1 to 9 relative to that of the persistently poor readers. The Grade Linear × Compensated Readers coefficient was 1.51 and did not differ significantly from the persistently poor reading group. The corresponding linear growth of the midrange readers (−2.07) and good readers (−4.08) groups were significantly smaller than the persistently poor readers. Similarly, the Grade Quadratic × Reading Group interactions assessed the average quadratic growth rate in Passage Comprehension made by each reading group relative to that of the persistently poor group over the five grade levels. The regression weight associated with Quadratic × Compensated Readers (0.27) was the estimated deviation of the compensated readers' average quadratic growth rate from the average quadratic growth for the persistently poor readers. Thus, the quadratic rate for the compensated readers was −6.77 (−7.04 + 0.27). The compensated readers group was characterized by a combination of slightly increased linear growth and slightly, but nonsignificantly, less deceleration in its growth curve than the persistently poor readers as they progress through the grades. The midrange readers group had significantly less linear growth and slightly, but not significantly, slower deceleration in its growth curve relative to that of the persistently poor readers. The good readers group had significantly less linear growth and significantly less deceleration in its growth curve than the persistently poor readers −4.52 (−7.04 + 2.52) as they progress through the grades. The random part of the mixed models is presented in the lower portion of Table 1. The first term for the growth model (Model 1), 3.31, is the standard deviation of the individual linear slopes; the second term, 3.32, is the standard deviation of the individual intercepts or levels; the third term, −.27, is the correlation between the individual intercepts and the individual slopes. The ICC = .47 and the BIC = 12,076.52 for the Growth Model 1.

Figure 1 presents the smoothed growth curves for WJ Passage Comprehension plotted for the four groups from Grades 1 to 9. The results of Model 1 indicate that the elevation or levels of the growth curves for the compensated, midrange, and good readers were all significantly higher than that of the persistently poor readers and that the compensated readers had a steeper observed linear slope than all the other groups. The compensated readers begin below the midrange readers and the good readers in Grade 1 and arrive at Grade 9 exceeding the performance of the midrange readers and reducing its gap with the good readers.

Model 2 in Table 1 adds the reading and verbal ability measures as time-varying covariates to Model 1. The pattern of results for the groups and group interactions with growth in Model 2 were consistent with those obtained in Model 1, with a substantial reduction (79%) in the linear growth parameter (to 4.27). The adjusted group mean differences were no longer statistically significant, with the exception of the good readers group, whose adjusted mean was .81 points higher than that of the persistently poor readers. The reduction in the between-reader-group means averaged 95%, indicating that a large proportion of between-group variability is accounted for in the model. The standardized coefficient for WJ Letter-Word Identification was .54, indicating that much of the between-group variability accounted for by word reading skill. The standardized coefficient for WJ Word Attack was .12, indicating that decoding skill contributes to Passage Comprehension. The standardized coefficients for the four measures of verbal ability were relatively small (.04-.08), but all were statistically significant ($p < .05$), indicating that the verbal abilities also contribute to Passage Comprehension. For the random effects for Model 2, the standard deviation of slopes and constant were reduced from those in Model 1 and the correlation between mean and constant was larger and positive ($r = .50$). The ICC of Model 2 was .15, a reduction of 67% in within-participant variation unaccounted for relative to Model 1. The Model 2 ICC = .15, a 67% reduction in the within-participant variance remaining unaccounted for in the adjusted model. The Model 2 BIC = 1,031.70, an improvement of fit from the Growth Model 1, $\chi^2(6) = 1044.2$, $p < .00001$.

Model 3 in Table 1 is the growth model for Grades 1 to 5. As would be expected, the linear growth from Grades 1 to 5 is reduced to 15.34, a 30% reduction in linear growth compared with Model 1. The group mean differences are reduced for the Compensated (4.70) and Midrange Readers (7.13), and increase for the Good Readers (12.36). The pattern of the Grade Linear × Reader Group and Grade Quadratic × Reader group interactions is similar to those found in Model 1, with the exception of the nonsignificant Grade Quadratic × Good readers in Model 3. The random effects for Model 3 are similar to those in Model 1. The standard deviations of slopes and constants are slightly larger and the correlation between those parameters is substantial ($r = -.52$) and remains negative. The Model 3 ICC = .57 and BIC = 7484.17.

Model 4 in Table 1 is the growth model, including all time-varying covariates, for Model 3 in Grades 1 to 5. The linear growth from Grades 1 to 5 was reduced to 3.14, an 80% reduction in linear growth compared with Model 3. Again, the adjusted group mean differences were no longer statistically significant, with the exception of the good readers group, whose adjusted mean was 1.37 points higher than that of the persistently poor readers. The reduction in the between-reader-group means averaged 90%, again indicating that a large proportion of between-group variability is accounted for in the model. The standardized coefficient for WJ Letter-Word Identification was .56, again suggesting that much of the between-group variability accounted for by word reading skill. The standardized coefficient for WJ Word Attack again was .12, indicating that decoding skill contributes to Passage Comprehension. The standardized coefficients for the four measures of verbal ability again were relatively small (.04-.10), and all but Vocabulary were statistically significant ($p < .05$) indicating that the three other verbal abilities also contribute to Passage Comprehension with Information having the highest loading. The notable random effect for Model 4 is the reduction in the correlation between slopes and intercepts ($r = .03$) to nonsignificance. The Model 4 ICC = .13, a 78% reduction in the within-participant variance remaining unaccounted for in the adjusted model. The Model 4 BIC = 6687.86, an improvement of fit from the Growth Model 3, $\chi^2(6) = 766.32$, $p < .00001$.

Model 5 in Table 1 is the growth model for Grades 5 to 9. As would be expected, the linear growth from Grades 5 to 9 is reduced (to 5.27), a 76% reduction in linear growth compared with Model 1. Also of note is the small, but statistically significant Grade Quadratic coefficient (.74), a 90% reduction in the deceleration rate in Grades 5 to 9 relative to that for Grades 1 to 9. The reading group mean differences are reduced by an average of 78%, ranging from 5.46 to 9.88

points and each group was significantly different from the persistently poor readers ($p < .05$). The notable random effect for Model 5 was the nonsignificant correlation between slopes and constants ($r = .16$). The Model 5 ICC = .59 and the BIC = 6919.10.

Model 6 in Table 1 is the growth model, adding all time-varying covariates to Model 5 for Grades 5 to 9. The linear growth from Grades 5 to 9 was reduced to 1.69, a 69% reduction in linear growth compared with Model 5. The three adjusted group means all remained significantly different from the persistently poor readers. The reduction in the between-reader-group means averaged 78%, again indicating that a substantial but somewhat smaller proportion of between-group variability is accounted for in the model. The standardized coefficient for WJ Letter-Word Identification was .28, a 50% reduction from Models 1 and 3, but still the strongest association with Passage Comprehension in Grades 5 to 9. The standardized coefficient for WJ Word Attack again was .08, a 33% reduction from Models 1 and 3 indicating that decoding skill contributes to a slightly lesser degree to Passage Comprehension in Grades 5 to 9. The standardized coefficients for all four measures of verbal ability were statistically significant ($p < .05$), indicating that the four verbal abilities also contribute to Passage Comprehension in Grades 5 to 9. Vocabulary achieved the highest standardized loading (.13) across all three covariate models. The notable random effect for Model 6 is the somewhat higher, but nonsignificant, correlation between slopes and intercepts ($r = .26$). The Model 6 ICC = .29, a 50% reduction in the within-participant variance remaining unaccounted for in the adjusted model and BIC = 6568.97, an improvement of fit from the Growth Model 5, $\chi^2(6) = 766.32$, $p < .00001$.

Discussion

This is the first study to utilize data collected from a representative longitudinal sample of students followed prospectively from kindergarten entry through ninth grade that provides direct evidence that the four components of verbal ability contribute unique variance to growth in reading comprehension from Grades 1 to 9 while controlling for word and non-word reading. The variance accounted for by the reading and verbal ability measures effectively reduced the four reading groups to two: Only the good reader group could still be differentiated from the persistently poor reader group when the reading measures and four verbal abilities were taken into account. Although all four verbal abilities contributed significant variance to the growth of Passage Comprehension across the school years, the individual contributions were small relative to the large contribution of word reading and the somewhat smaller, but still relatively large contribution of non-word reading.

In the analysis of Grades 1 to 5, again, the variance accounted for by the two reading measures and four verbal abilities left only the good reader group to differ from the persistently poor reader group. Somewhat surprisingly, Vocabulary was the only measure that failed to account for significant unique variance in Passage Comprehension. Although that finding would seem to support the SVR interpretation of reading in the early grades, the three other verbal abilities accounted for unique variance in comprehension, thus suggesting that a more detailed account may be needed for the SVR even in the early grades (Cain, 2015).

The analysis of Grades 5 to 9 yielded a different pattern of results. Although word reading and non-word reading still accounted for somewhat less, but still a majority of variance in Passage Comprehension, pairwise differences remained between each reading group and the persistently poor readers. All four verbal abilities, and Vocabulary in particular, accounted for substantially larger unique variance in Passage Comprehension. These findings suggest that reading comprehension in the later grades moves beyond word recognition and decoding, and verbal ability to a broader array of understanding. The diminished role of word recognition and decoding in later grades is in general agreement with SVR findings (Cain, 2015). Inclusion of measures of

reasoning, inference, strategy use, or other aspects of comprehension may account for additional between-group variability present in the Grades 5 to 9 analysis.

Our findings extend the longitudinal (e.g., Verhoeven & Van Leeuwe, 2008) and cross-sectional (e.g., Protopapas, Sideridis, Mouzaki, & Simos, 2007) evidence that vocabulary plays a unique role in the development of comprehension. That Information, Similarities, Vocabulary, and Comprehension each contributed unique variance to Passage Comprehension gives specificity to some of the components underlying the linguistic knowledge assessed by listening comprehension in the SVR. This expansion from vocabulary alone to verbal abilities in general is also consistent with the LQH to the extent that enhanced word knowledge would grow with the acquisition of factual knowledge, reasoning, and social and cultural awareness assessed by verbal ability measures. Similarly, the results of the Grades 5 to 9 analysis are consistent with the DIME model of comprehension in older readers. Ahmed et al. (2016) validated the DIME model for readers in Grades 7 to 12 following the approach taken by Cromley and Azevedo (2007) and Cromley et al. (2010) but with an important analytic distinction. Although Ahmed et al. (2016) carefully constructed content-specific mediator measures of background knowledge, vocabulary, and inference-making, they took an extra step to remove statistically the confounding common method variance induced by the reading skills required to respond to the mediator and comprehension tests. Removal of the confounding common variance reduced the direct and indirect effects in the DIME model. In the present study, the method confounds are eliminated by design, rather than analysis, because the measures of verbal ability and their corresponding relations to comprehension do not require reading. Perhaps more important, the non-content-specific verbal ability measures used here accounted for substantial variability in Passage Comprehension in the later grades suggests that content-specific measures may not be required to reveal the direct and mediated effects of the DIME model, particularly for reading tests as opposed to subject matter achievement tests. Moreover, the strong relation between Vocabulary and Passage Comprehension found in the later grades in this study highlights the importance of vocabulary depth. The knowledge required to recall, rather than to recognize a definition for a particular word combined with a scoring procedure that accounts for the degree of precision of the examinee response reflect vocabulary depth. Cain and Oakhill (2014) demonstrated that vocabulary depth is related to higher level inference in reading comprehension after accounting for vocabulary breadth.

Several recent studies have suggested that oral language development may be central to improving reading skills in general, and may be crucial for assisting young struggling, dyslexic readers to compensate for any difficulties with decoding: before (Dickinson & Porche, 2011; Neuman, Newman, & Dwyer, 2011), during (e.g., Kendeou, van den Broek, White, & Lynch, 2009), and continuing after receiving appropriate phonologically based interventions. Our findings suggest that consistent vocabulary instruction over time may provide critical support for the development of reading comprehension, particularly for disadvantaged readers already in school. Biemiller (2006) found that by the end of second grade, children in the bottom quartile of vocabulary lack one in every three root words possessed by their peers in the top quartile of the vocabulary distribution. Experimental evidence has suggested that vocabulary knowledge can be improved through instruction for school-aged children (e.g., Beck & McKeown, 2007), and that frequency of use and context may be most important factors for vocabulary acquisition (Nash & Snowling, 2006). Biemiller and Boote (2006) demonstrated that repeated readings by the teacher combined with explanations of target word meanings improved the vocabulary knowledge of students in primary grades in schools where about half were English language learners. The results suggested that teaching approximately 25 vocabulary words per week (about 1,000 per year) would yield average increases in vocabulary knowledge of approximately 400 words per year in these students. Although the gain of 400 words per year is substantial, it does not substantially reduce the gap between the highest and lowest quartiles for vocabulary.

A growing body of evidence suggests that differences in the quality and quantity of exposure to language and vocabulary in early childhood (Weisleder & Fernald, 2013; Weizman & Snow, 2001) and verbal interaction with parents and caregivers (Cabell, Justice, McGinty, DeCoster, & Forston, 2015; Marchman & Fernald, 2008; Zimmerman et al., 2009) are associated with improved language and vocabulary later in childhood. Other studies have identified relations between early vocabulary learning and later reading comprehension (Dickinson & Porche, 2011; Durand, Loe, Yeatman, & Feldman, 2013; Hulme, Nash, Gooch, Lervåg, & Snowling, 2015). These language studies, combined with our findings, suggest that attention to both oral language and beginning reading skills will be needed to address the persistent achievement gap in reading (Ferrer et al., 2015). Thus, conversation- and interaction-based intervention and instruction in oral language and vocabulary development in infancy and early childhood that continues throughout the school years (Dickinson, Golinkoff, & Hirsh-Pasek, 2010), combined with evidence-based instruction that systematically develops the skills of phonologic awareness, decoding, word reading, fluency, and comprehension in school, may provide a pathway to reducing the achievement gap in reading.

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References

Ahmed, Y., Francis, D. J., York, M., Fletcher, J. M., Barnes, M., & Kulesz, P. (2016). Validation of the direct and inferential mediation (DIME) model of reading comprehension in grades 7 through 12. *Contemporary Educational Psychology*, *44*, 68-82.

Beck, I. L., & McKeown, M. G. (2007). Increasing young low-income children's oral vocabulary repertoires through rich and focused instruction. *The Elementary School Journal*, *107*, 251-271. doi:10.1086/511706

Biemiller, A. (2006). Vocabulary development and instruction: A prerequisite for school learning. In D. K. Dickenson & S. B. Neuman (Eds.), *Handbook of early literacy research* (Vol. 2, pp. 41-51). New York: The Guilford Press.

Biemiller, A., & Boote, C. (2006). An effective method for building meaning vocabulary in primary grades. *Journal of Educational Psychology*, *98*, 44-62.

Braze, D., Katz, L., Magnuson, J. S., Mencl, W. E., Tabor, W., Van Dyke, J. A., . . . Shankweiler, D. P. (2016). Vocabulary does not complicate the simple view of reading. *Reading and Writing, 29*, 435-451. STET.

Braze, D., Tabor, W., Shankweiler, D. P., & Mencl, W. (2007). Speaking up for vocabulary: Reading skill differences in young adults. *Journal of Learning Disabilities*, *40*, 226-243.

Brimo, D., Apel, K., & Fountain, T. (2015). Examining the contributions of syntactic awareness and syntactic knowledge to reading comprehension. *Journal of Research in Reading*. Advance online publication. doi:10.1111/1467–9817.12050

Cabell, S. Q., Justice, L. M., McGinty, A. S., DeCoster, J., & Forston, L. D. (2015). Teacher-child conversations in preschool classrooms: Contributions to children's vocabulary development. *Early Childhood Research Quarterly*, *30*(Pt. A), 80-92. doi:10.1016/j.ecresq.2014.09.004

Cain, K. (2015). Learning to read: Should we keep things simple? *Reading Research Quarterly*, *50*, 151-169.

Cain, K., & Oakhill, J. (2006). Assessment matters: Issues in the measurement of reading comprehension. *British Journal of Educational Psychology*, *76*, 697-708. doi:10.1348/000709905X69807

Cain, K., & Oakhill, J. (2014). Reading comprehension and vocabulary: Is vocabulary more important for some aspects of comprehension? *L'Année Psychologique*, *114*, 647-662. doi:10.4074/S0003503314004035

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, *96*, 31-42. doi:10.1037/0022-0663.96.1.31

Catts, H. W., Hogan, T. P., & Adlof, S. M. (2005). Developmental changes in reading and reading disabilities. In *The connections between language and reading disabilities* (pp. 25-40). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Cromley, J. G., & Azevedo, R. (2007). Testing and refining the direct and inferential mediation model of reading comprehension. *Journal of Educational Psychology*, *99*, 311-325. doi:10.1037/0022-0663.99.2.311

Cromley, J. G., Snyder-Hogan, L. E., & Luciw-Dubas, U. A. (2010). Reading comprehension of scientific text: A domain-specific test of the direct and inferential mediation model of reading comprehension. *Journal of Educational Psychology*, *102*, 687-700. doi:10.1037/a0019452

Cutting, L. E., & Scarborough, H. S. (2006). Prediction of reading comprehension: Relative contributions of word recognition, language proficiency, and other cognitive skills can depend on how comprehension is measured. *Scientific Studies of Reading*, *10*, 277-299. doi:10.1207/s1532799xssr1003_5

Dickinson, D. K., Golinkoff, R. M., & Hirsh-Pasek, K. (2010). Speaking out for language why language is central to reading development. *Educational Researcher*, *39*, 305-310.

Dickinson, D. K., & Porche, M. V. (2011). Relation between language experiences in preschool classrooms and children's kindergarten and fourth-grade language and reading abilities. *Child Development*, *82*, 870-886.

Durand, V. N., Loe, I. M., Yeatman, J. D., & Feldman, H. M. (2013). Effects of early language, speech, and cognition on later reading: A mediation analysis. *Frontiers in Psychology, 4*. doi: 10.3389/fpsyg.2013.00586

Ferrer, E., McArdle, J. J., Shaywitz, B. A., Holahan, J. M., Marchione, K., & Shaywitz, S. E. (2007). Longitudinal models of developmental dynamics between reading and cognition from childhood to adolescence. *Dev Psychol, 43*(6), 1460-1473. doi: 2007-16709-014 [pii] 10.1037/0012-1649.43.6.1460

Ferrer, E., Shaywitz, B. A., Holahan, J. M., Marchione, K., & Shaywitz, S. E. (2010). Uncoupling of reading and IQ over time: Empirical evidence for a definition of dyslexia. *Psychological Science, 21*(1), 93-101.

Ferrer, E., Shaywitz, B. A., Holahan, J. M., Marchione, K. E., Michaels, R., & Shaywitz, S. E. (2015). Achievement gap in reading is present as early as first grade and persists through adolescence. *The Journal of pediatrics, 167*(5), 1121-1125.

Foorman, B. R., Herrera, S., Petscher, Y., Mitchell, A., & Truckenmiller, A. (2015). The structure of oral language and reading and their relation to comprehension in kindergarten through grade 2. *Reading and Writing*, *28*, 655-681. doi:10.1007/s11145-015-9544-5

Foorman, B. R., Koon, S., Petscher, Y., Mitchell, A., & Truckenmiller, A. (2015). Examining general and specific factors in the dimensionality of oral language and reading in 4th-10th grades. *Journal of Educational Psychology*, *107*, 884-899. doi:10.1037/edu0000026

Fraser, J., & Conti-Ramsden, G. (2008). Contribution of phonological and broader language skills to literacy. *International Journal of Language & Communication Disorders*, *43*, 552-569. doi:10.1080/13682820701778069

Garcia, J., & Cain, K. (2014). Decoding and reading comprehension: A meta-analysis to identify which reader and assessment characteristics influence the strength of the relationship in English. *Review of Educational Research*, *84*(1), 74-111. doi:10.3102/0034654313499616

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial & Special Education*, *7*, 6-10.

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing*, *2*, 127-160. doi:10.1007/BF00401799

Hulme, C., Nash, H. M., Gooch, D., Lervåg, A., & Snowling, M. J. (2015). The foundations of literacy development in children at familial risk of dyslexia. *Psychological Science*, *26*, 1877-1886. doi:10.1177/0956797615603702

Kaufman, A. S. (1975). Factor analysis of the WISC-R at 11 age levels between 61/2 and 161/2 years. *Journal of Consulting and Clinical Psychology*, *43*(2), 135-147. doi: 10.1037/h0076502

Keenan, J. M., Betjemann, R. S., & Olson, R. K. (2008). Reading comprehension tests vary in the skills they assess: Differential dependence on decoding and oral comprehension. *Scientific Studies of Reading*, *12*, 281-300. doi:10.1080/10888430802132279

Kendeou, P., van den Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology*, *101*, 765-778. doi:10.1037/a0015956

Marchman, V. A., & Fernald, A. (2008). Speed of word recognition and vocabulary knowledge in infancy predict cognitive and language outcomes in later childhood. *Developmental Science*, *11*(3), F9-F16. doi:10.1111/j.1467-7687.2008.00671.x

Nash, H., & Snowling, M. (2006). Teaching new words to children with poor existing vocabulary knowledge: A controlled evaluation of the definition and context methods. *International Journal of Language & Communication Disorders*, *41*, 335-354. doi:10.1080/13682820600602295

National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Washington, DC: The National Institute of Child Health and Human Development.

Neuman, S. B., Newman, E. H., & Dwyer, J. (2011). Educational effects of a vocabulary intervention on preschoolers' word knowledge and conceptual development: A cluster-randomized trial. *Reading Research Quarterly*, *46*, 249-272.

Ouellette, G., & Beers, A. (2010). A not-so-simple view of reading: How oral vocabulary and visual-word recognition complicate the story. *Reading and Writing*, *23*, 189-208. doi:10.1007/s11145-008-9159-3

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*, 357-383.

Perfetti, C. (2011). Phonology is critical in reading: But a phonological deficit is not the only source of low reading skill. In S. A. Brady, D. Braze, & C. A. Fowler (Eds.), *Explaining individual differences in reading: Theory and evidence* (pp. 137-152). New York, NY: Psychology Press.

Perfetti, C., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading*, *18*, 22-37. doi:10.1080/10888438.2013.827687

Price, C. J., & Devlin, J. T. (2011). The interactive account of ventral occipitotemporal contributions to reading. *Trends in Cognitive Sciences*, *15*, 246-253.

Protopapas, A., Mouzaki, A., Sideridis, G. D., Kotsolakou, A., & Simos, P. G. (2013). The role of vocabulary in the context of the simple view of reading. *Reading & Writing Quarterly: Overcoming Learning Difficulties*, *29*, 168-202. doi:10.1080/10573569.2013.758569

Protopapas, A., Sideridis, G. D., Mouzaki, A., & Simos, P. G. (2007). Development of lexical mediation in the relation between reading comprehension and word reading skills in Greek. *Scientific Studies of Reading*, *11*, 165-197.

Rabe-Hesketh, S., & Skrondal, A. (2008). *Multilevel and longitudinal modeling using stata* (2nd ed.). College Station, TX: Stata Press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models*. Thousand Oaks, CA: Sage.

Sattler, J. M. (1990). *Assessment of children* (3rd ed.). San Diego, CA: Jerome M. Sattler.

Shaywitz, B., Holford, T., Holahan, J., Fletcher, J., Stuebing, K., Francis, D., . . . Shaywitz, S. (1995). A Matthew effect for IQ but not for reading: Results from a longitudinal study. *Reading Research Quarterly, 30*(4), 894-906.

Shaywitz, S. E., Fletcher, J. M., Holahan, J. M., Shneider, A. E., Marchione, K. E., Stuebing, K. K., . . . Shaywitz, B. A. (1999). Persistence of dyslexia: The Connecticut Longitudinal Study at adolescence. *Pediatrics, 104*(6), 1351-1359.

Shaywitz, S. E., Shaywitz, B. A., Fulbright, R. K., Skudlarski, P., Mencl, W. E., Constable, R. T., . . . Gore, J. C. (2003). Neural systems for compensation and persistence: Young adult outcome of childhood reading disability. *Biol Psychiatry, 54*(1), 25-33.

StataCorp. (2007). *Stata longitudinal/panel data reference manual*. College Station, TX: Stata Press.

StataCorp. (2013). *Stata 13: StataCorp LP*. College Station, TX. Available from http://www.stata.com

Thorndike, E. L. (1914). Communications and discussion. Repetition versus recall in memorizing vocabularies; The effect of continuous exercise and of rest upon difficult mental multiplication. *Journal of Educational Psychology*, *5*, 596-599. doi:10.1037/h0072245

Tighe, E. L., Wagner, R. K., & Schatschneider, C. (2015). Applying a multiple group causal indicator modeling framework to the reading comprehension skills of third, seventh, and tenth grade students. *Reading and Writing*, *28*, 439-466. doi:10.1007/s11145-014-9532-1

Tilstra, J., McMaster, K., Van den Broek, P., Kendeou, P., & Rapp, D. (2009). Simple but complex: Components of the simple view of reading across grade levels. *Journal of Research in Reading*, *32*, 383-401. doi:10.1111/j.1467-9817.2009.01401.x

Verhoeven, L., & Van Leeuwe, J. (2008). Prediction of the development of reading comprehension: A longitudinal study. *Applied Cognitive Psychology*, *22*, 407-423. doi:10.1002/acp.1414

Wechsler, D. (1981). *Wechsler Intelligence Scale for Children–Revised*. New York, NY: Psychological Corporation.

Weisleder, A., & Fernald, A. (2013). Talking to children matters: Early language experience strengthens processing and builds vocabulary. *Psychological Science*, *24*, 2143-2152. doi:10.1177/0956797613488145

Weizman, Z. O., & Snow, C. E. (2001). Lexical output as related to children's vocabulary acquisition: Effects of sophisticated exposure and support for meaning. *Developmental Psychology*, *37*, 265-279.

Wood, D. E. (2009). Modeling the relationships between cognitive and reading measures in third and fourth grade children. *Journal of Psychoeducational Assessment*, *27*, 96-112. doi:10.1177/0734282908323609

Woodcock, R. W. (1977). *Woodcock-Johnson Psycho-Educational Battery*. Technical Report. Allen, TX: DLM.

Woodcock, R. W., & Johnson, M. B. (1977). *The Woodcock-Johnson Psycho-Educational Battery*. Allen, TX: DLM Teaching Resources.

Zimmerman, F. J., Gilkerson, J., Richards, J. A., Christakis, D. A., Xu, D., Gray, S., & Yapanel, U. (2009). Teaching by listening: The importance of adult-child conversations to language development. *Pediatrics*, *124*, 342-349.