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THE COMPONENTS OF THE SIMPLE VIEW OF READING: A CONFIRMATORY FACTOR ANALYSIS

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The simple view of reading admits two components in accounting for individual differences in reading comprehension: a print-dependent component related to decoding and word identification, and a print-independent one related to oral language comprehension. It has been debated whether word or nonword reading is a better index of the print-dependent component and whether vocabulary measures fit within the print-independent component or constitute an additional factor. Here we apply a confirmatory factor analysis on a set of relevant measures from 488 Greek children in Grades 3–5 independently of reading comprehension. The results indicate that word and nonword reading do not constitute distinct factors but covary along the same two dimensions of accuracy and fluency. Oral vocabulary measures group with listening comprehension, resulting in excellent model fits. Strong correlations were observed between the latent factors of the purported print-dependent and print-independent components, consistent with an approach that focuses on the strong relations among semantic, orthographic, and phonological aspects of word representations.

The simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) is an influential theory of individual differences in reading comprehension. Its major theoretical force derives from the separation between a print-dependent and a print-independent component. Specifically, the simple view posits that an individual's reading comprehension performance (R) is a product of their decoding skills (D) and their oral language

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comprehension (L): R = D × L. This is the equation of the simple view. It is a product, and not a sum, in order to express the obvious point that both components are necessary for any nonzero level of reading comprehension. Without a minimum of decoding and some language comprehension ability, reading comprehension is impossible.

Despite a longstanding dominance in reading research, all three constructs involved in the simple view remain controversial as far as their proper measurement is concerned. In the present study we are not concerned with the measurement of reading comprehension itself. We simply note that research has indicated that different purported measures of comprehension do not all measure the same thing (Keenan, Betjemann, & Olson, 2008), they are differently related to other measures (Cutting & Scarborough, 2006; Francis et al., 2006; Spear-Swerling, 2004), and they may fail to capture variance related to aspects considered important in educational settings (Fletcher, 2006; Sweet, 2005). In this study we are concerned with the constituent components of reading comprehension as posited by the simple view. With respect to the print-dependent component, we consider measures of word and nonword reading accuracy and fluency. As far as the print-independent component is concerned, we examine the role of vocabulary measures in combination with more typical listening comprehension measures.

The Print-Dependent Component

Hoover and Gough (1990) posited the print-dependent component as a measure of "decoding skill," specifically defined as "efficient word recognition." However, it is not clear how this skill is supposed to be measured, and whether the intended construct is best indicated by the recognition of known words or by the ability to pronounce unknown letter strings (pseudowords). Hoover and Gough noted specifically that, for the beginning reader, decoding skill concerns "[the derivation of] appropriate phonological representations for . . . novel printed inputs" (p. 130), a task functionally equivalent to nonword reading, possibly based on letter-sound correspondence rules (Gough & Tunmer, 1986).

So an important question concerns the relation of word and nonword reading ability to reading comprehension. One approach to this issue is to examine the relation between word and nonword reading, investigating specifically whether the two types of testing material assess distinct skill domains. If word reading varies along a different dimension from nonword reading, then the two may follow distinct developmental trajectories and may be differently related to comprehension. If, however, word and nonword reading are two similar ways to measure one basic underlying reading skill, then it may not be constructive to try and tease apart their separate contributions to reading comprehension, because a host of measurement issues concerning reliability and validity are already obscuring the distinctions and hinder our ability to make such fine distinctions in the first place.

The relative importance of word vs. nonword reading in accounting for reading comprehension has been examined, directly or indirectly, in a number of previous studies. Chen and Vellutino (1997) tested average readers in Grades 2–7 and found no difference between word and nonword reading as measures of decoding ability. Shankweiler et al. (1999) tested children in early school grades, including a high proportion of poor readers, and concluded that nonword reading is not separable from word reading. More recently, Savage (2006) tested teenage poor readers and found that nonword and word reading (including a fluency measure) all loaded on a common "decoding" factor. However, based on the patterns of associations among all variables, Savage concluded that "the precise measure of decoding used had a significant impact on the explanatory power of listening comprehension and verbal cognitive ability" (p. 158).

In a related vein, Goff, Pratt, and Ong (2005) tested schoolchildren in Grades 3–5 from the general population and found that irregular word reading made an independent contribution to reading comprehension beyond nonword reading, whereas the converse was not true. Ouellette (2006) tested typically developing 4th-grade children and concluded that word and nonword reading constitute distinct skill domains because they exhibit distinct patterns of relations to vocabulary breadth and depth measures and to reading comprehension. Ouellette and Beers (2010) also provided evidence for a differential role of words and nonwords. Specifically, testing children in Grades 1 and 6, they found unique contributions from both nonword and irregular word reading. These findings, however, make a somewhat distinct point related to irregular vs. regular orthographic patterns and not necessarily between known/familiar (word) and unknown (nonword) letter strings.

The purported distinction between word and nonword reading does not exhaust the controversy regarding the reading measures related to the print-dependent component, because speed and fluency aspects may also contribute to the decoding construct(s). Joshi and Aaron (2000) tested 3rd-grade children using nonword reading to measure decoding. They added naming speed to the simple view equation and found that it contributed an additional 10% of comprehension variance after decoding and listening comprehension. Following up on that, Johnston and Kirby (2006) showed that this significant contribution of naming is due to measurement of decoding with nonwords and largely disappears when decoding is measured using word reading. They hypothesized that the "effect [of naming] is already included within the word recognition product term" (p. 358). More recently, Georgiou, Das, and Hayward (2009) also found no unique contribution of naming speed to reading comprehension in a special sample of Grade 3–4 children from low socioeconomic backgrounds with poor comprehension skills.

Measuring reading fluency directly, rather than naming speed, Riedel (2007) found passage reading fluency to be a strong concurrent and longitudinal predictor of reading comprehension in Grades 1 and 2, while Tilstra, McMaster, Van den Broek, Kendeou, and Rapp (2009) found that fluency accounted for additional reading comprehension variance after word-level decoding, listening comprehension, and verbal proficiency in Grades 4, 7, and 9. On the other hand, Adlof, Catts, and Little (2006) tested children in Grades 2, 6, and 8 and found no unique contribution of a reading fluency composite to reading comprehension, either concurrently or longitudinally.

In sum, there are questions regarding the conceptualization of the decoding component related both to the materials used to assess reading skill (words vs. nonwords) as well as the nature of the measures (speed vs. accuracy). In the present study we investigate interrelations among these two dimensions of reading skill assessment. Due to the relatively high transparency of the Greek orthography (Protopapas & Vlahou, 2009) and consequent dearth of irregular words, we do not concern ourselves with the notion of irregular words, which arguably brings issues of vocabulary depth and executive inhibition into the picture. Rather, we concentrate on the distinction between familiar and unknown letter strings, measured in terms of accuracy and fluency.

The Print-Independent Component

Researchers typically measure the print-independent component using listening comprehension measures. These are similar to reading comprehension measures but differ in presenting the material orally rather than in print. Although this aspect of the print-independent component is relatively uncontroversial, the role of vocabulary measures has recently received much attention and remains in need of further clarification.

Vocabulary, at least when measured with oral presentation and response, not involving any written material, is arguably an oral language skill. Therefore, to the extent that vocabulary measures belong with the single view at all, they should form part of the oral language component, grouping with listening comprehension (as in Kendeou, van der Broek, White, & Lynch, 2009). However, this intuitive view has been challenged by findings that vocabulary accounts for additional reading comprehension variance after listening comprehension is statistically controlled (Braze, Tabor, Shankweiler, & Mencl, 2007; Goff et al., 2005; Ouellette & Beers, 2010; Seigneuric & Ehrlich, 2005; Tilstra et al., 2009), at least for children past the early stages of learning to read (Sénéchal, Ouellette, & Rodney, 2006; Verhoeven & van Leeuwe, 2008). Furthermore, vocabulary has been found to correlate highly with word recognition measures (Kendeou, Savage, & van den Broek, 2009; Ouellette, 2006) and to take up much or most of reading comprehension variance associated with print-dependent measures, such as word accuracy and fluency (Protopapas, Sideridis, Simos, & Mouzaki, 2007).

The relation of vocabulary to word recognition has been noted in the general population as well as in special subgroups, over a wide age range. Catts, Adlof, and Weismer (2006) found that 8th-grade poor decoders scored lower on oral receptive vocabulary than typical children matched on reading comprehension. Wise, Sevcik, Morris, Lovett, and Wolf (2007) found that vocabulary measures significantly predict both prereading and reading skills in Grade 2–3 children with reading difficulties.

Hagtvet (2003) found significant differences in vocabulary scores between 2nd-grade poor, average, and good decoders. Significant correlations between passage reading measures (accuracy and rate) and verbal ability scales, such as word definitions and similarities, were also reported by Savage (2006) among adolescent poor readers. Finally, Cain, and Oakhill (2006) found that vocabulary predicted longitudinal progress in word reading accuracy for 7–9-year-old poor comprehenders.

The introduction of vocabulary measures into the explanation of reading comprehension brings into question the status of the oral language component of the simple view. The relation of vocabulary to listening comprehension measures may be uncontroversial; however, the correlation between vocabulary and reading measures (e.g., word recognition) threatens the validity of the simple view notion of two dissociable components, each contributing independent variance to reading comprehension. Therefore, it is imperative to examine the extent to which vocabulary is both conceptually and empirically a constituent of the print-independent component.

Aims of the Current Study

In the present study we do not seek to account for reading comprehension variance. We take an alternative approach in an attempt to help clarify the constituents of the two components of the simple view, by testing different groupings of commonly employed measures using confirmatory factor analysis. This approach will not indicate what amounts of reading comprehension variance may be accounted for, uniquely or in combination, by the predictor measures. It may, however, shed light on the pattern of covariances among measures and aid their characterization as distinct versus potentially contributing to common latent factors, which may in turn account more parsimoniously for reading comprehension variance. To achieve that goal, we systematically examine alternative, theoretically justified compositions of the two simple view components.

In sum, our research questions are: (a) What is the proper conceptualization of the print-dependent component of the simple view, taking into account word and nonword measures of accuracy and fluency? Is it a unitary component or should it be treated as composed of separate subskills? (b) How are vocabulary measures related to the print-independent component of the simple view? Is vocabulary part of a unified oral language component or should it be viewed as a separate skill? (c) How strongly interrelated are the two components of the simple view with all aforementioned measures included as indicators?

Method

Our data are derived from the University of Crete longitudinal study of the development of reading skills, a project that aimed to follow 600 schoolchildren from Grades 2–4 through Grades 4–6. Additional details on test construction and analyses from the first wave of measurements have been reported in Sideridis, Mouzaki, Simos, and Protopapas (2006) and in Protopapas et al. (2007).

Participants

This analysis concerns data from the 3rd wave of measurements of a longitudinal study in 17 Greek elementary schools in Crete, Attica (including the Athens metropolitan area), and the Ionian islands. Children were selected randomly from each class. Table 1 shows their distribution by sex and grade at the time of data collection. All children were fluent speakers of Greek and none were retained in the same grade or were in special education classes. Data from 488 children in Grades 3–5 are reported here, including all children with complete datasets in the selected measures.

Procedure

Data for the analyses reported here were collected in a 40-minute session during April 2006, except for the Verbal Instructions scale,

TABLE 1 Number of Boys and Girls, and Mean Age (in Months) per Grade

	Number of children		Age	
Grade	Boys	Girls	*M*	*SD*
3	84	86	93.7	3.9
4	77	86	105.4	3.8
5	73	82	117.4	4.4

which was administered in Wave 2 (November, 2005). Children were tested individually by specially trained research assistants in a quiet room in their school, with the consent of their parents.

Measures

Word reading accuracy was assessed with subscale 5 of the Test of Reading Performance (TORP-5; Sideridis & Padeliadou, 2000). Children read out loud a list of 40 two- to five-syllable-long words printed in two columns in order of increasing difficulty, without time pressure. Each word was scored with zero (incorrect reading), one (phonologically accurate but incorrectly stressed) or two (correct reading) points. Testing was discontinued after six incorrect items.

Pseudoword reading accuracy was tested with subscale 6 of the Test of Reading Performance (TORP-6; Sideridis & Padeliadou, 2000). Children read out loud a list of 19 two- to three-syllable-long pseudowords printed in order of increasing difficulty, without time pressure. Scoring was the same as for word reading accuracy. Testing was discontinued after six incorrect items.

Word reading fluency was tested with a sheet of 112 one- to six-syllable words printed in four columns in order of increasing length, which children had to read as quickly as possible, scoring one point for each word read accurately (including stress) within 45 seconds.

Pseudoword reading fluency was tested with a sheet of 70 one- to six-syllable pseudowords printed in three columns in order of increasing length, which children had to read as quickly as possible within 45 seconds. Scoring was the same as for word reading fluency.

Listening comprehension was tested with three passages (two narrative and one expository, 84 to 97 words long), presented orally by the experimenter, each followed by four multiple-choice comprehension questions. Each correct response (choice) was scored with one point.

Oral receptive language was also assessed with the Verbal Instructions scale—a variant of the Token test (Spreen & Benton, 1969, 1977) adapted for Greek-speaking children, in which participants were asked to respond to 28 verbal commands of increasing complexity involving pointing to tokens varying in size, color, shape, and location. Each correct response was scored with one point. Testing was discontinued after four consecutive incorrect responses.

Receptive vocabulary was tested with the Greek adaptation (Simos, Sideridis, Protopapas, & Mouzaki, in press) of the Peabody Picture Vocabulary Test–Revised (PPVT–R; Dunn & Dunn, 1981). In this task, each child was asked to identify one picture out of four that best represents the word spoken by the examiner. The 173 items are arranged in order of increasing difficulty, discontinuing testing after eight incorrect answers within 10 consecutive items. The total number of correct items was used in the analysis, including items preceding the initial six-correct baseline.

Expressive vocabulary was assessed with the vocabulary subtest of the WISC–III (Wechsler Intelligence Scales for Children, Greek standardization; Georgas, Paraskevopoulos, Bezevegis, & Giannitsas, 1997). In this task, children were asked to provide definitions for 30 word items, scored with two, one, or zero points each depending on word understanding and richness of expression. Testing was discontinued after four consecutive zero-scoring responses. Standard scores were used in the analyses.

Results

All measures except WISC-III Vocabulary scaled scores were converted to z-scores separately for each grade, then collapsed across grades. Word accuracy was transformed via an inverse function to reduce skewness. Three extreme outliers were removed from the dataset, including one from the word accuracy and two from the pseudoword accuracy score distributions. Table 2 lists descriptive statistics for the resulting dataset, separately for each grade, and Figure 1 plots the overall distributions against the normal curve in Q-Q plots. There is evidence for some mild ceiling effects; however, we do not believe that these are detrimental to our analyses because the most affected variables, namely word reading accuracy and listening comprehension, were among the strongest concurrent and longitudinal predictors of unique reading comprehension variance in this population (Protopapas, Mouzaki, Sideridis, Kotsolakou, & Simos, in press), suggesting that there

TABLE 2 Descriptive and Reliability Statistics for Each Measure

Measure	Maximum Range	Internal Consistency[a]	Test-retest Reliability[b]	Grade 3		Grade 4		Grade 5	
				M	*SD*	*M*	*SD*	*M*	*SD*
Word accuracy	0–80	.834	.782	73.8	6.2	75.8	6.3	77.3	5.0
Pseudoword accuracy	0–38	.920	.819	28.0	7.4	31.3	7.1	31.8	7.1
Word fluency	0–112	–[c]	.892	52.8	12.2	60.9	13.6	67.4	13.9
Pseudoword fluency	0–70	–[c]	.815	25.5	6.9	30.1	9.3	32.0	8.1
Listening comprehension	0–12	.485	–[d]	9.5	1.7	9.7	1.8	9.9	1.7
Verbal instructions	0–28	–[e]	–[d]	21.6	2.7	22.3	2.7	23.0	2.8
PPVT-R	0–173	.940	.768	118.8	15.2	128.6	12.8	133.8	12.0
WISC-III Vocabulary	–[f]	–[e]	.756[g]	9.8	2.9	9.9	3.0	9.0	3.4

[a]Cronbach's alpha.
[b]Six-month test-retest partial correlation coefficient controlling for grade.
[c]Not applicable due to lack of individual item measures.
[d]No retest available; administered only once.
[e]Item-level data not available.
[f]Standard scores ($M = 10$, $SD = 3$).
[g]One-year retest.

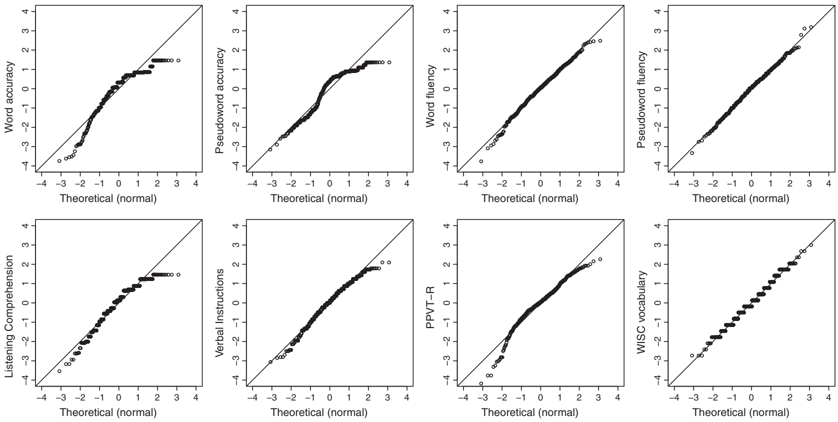

FIGURE 1 Normal quantile-quantile plots displaying the distribution of each variable against the theoretical normal distribution.

is abundant reliable and useful variance for the intended analysis. Table 3 shows the correlation and variance-covariance matrix of the data set, suggesting lack of multicollinearity.

Analyses were performed using the sem package (Fox, 2006) in R (R Development Core Team, 2005), after renormalizing each variable over the entire sample. For each analysis we report chi-square statistics, root-mean-square error of approximation (RMSEA) and associated 95% confidence interval (CI), Bentler's comparative fit index (CFI), standardized root mean square

TABLE 3 Variances (on the Diagonal), Covariances (Below the Diagonal), and Partial Correlations (Above the Diagonal) Among All Measures

	1	2	3	4	5	6	7	8
1. Word accuracy	4.066	.633	.532	.577	.306	.266	.399	.401
2. Pseudoword accuracy	1.304	.999	.462	.515	.253	.130	.245	.323
3. Word fluency	.993	.463	1.008	.711	.198	.211	.256	.327
4. Pseudoword fluency	1.124	.503	.754	.957	.194	.195	.235	.289
5. Listening comprehension	.477	.137	.207	.193	.934	.250	.427	.448
6. Verbal Instructions	.617	.248	.186	.215	.241	1.000	.417	.433
7. PPVT-R	.692	.239	.236	.216	.419	.418	.984	.628
8. WISC-III Vocabulary	2.571	.995	1.040	.937	1.322	1.373	1.994	9.875

Note. Partial correlations of untransformed and unstandardized variables, controlling for age. Variances and covariances of grade-standardized variables (and inverse-transformed word reading accuracy) as entered in the confirmatory factor analyses.

residual (SRMR), and Bayesian information criterion (BIC). Following Kline (2005), criteria for determining model fit included a nonsignificant model χ^2 ($p > .05$), RMSEA $< .05$, CFI $> .90$, and SRMR $< .10$.

In the analyses reported here, data from all three grades were pooled together, because pilot multigroup analyses in EQS, with and without equality constraints on loadings in different grades, indicated that there were no significant differences in factor structures among Grades 3–5. This is consistent with previous analyses of the data from the first measurement wave, in which some slopes in grade 2 structural models differed from the corresponding slopes in Grade 3 and Grade 4, but there were no significant differences between Grade 3 and Grade 4 models (Protopapas et al., 2007).

All displayed indicator loadings on the latent factors were statistically significant. Note that, due to the use of standardized scores in the analysis, standardized and unstandardized loadings are identical.

Print-Dependent Component

Three alternative structures of the reading component were tested, illustrated in Figure 2 along with corresponding standardized coefficients. The word-nonword structure (Figure 2, top) resulted in poor fit ($\chi^2 = 74.8$, $df = 1$, $p < .0005$, RMSEA $= .389$/CI .317–.466, CFI $= .919$, SRMR $= .063$, BIC $= 68.623$). The accuracy-fluency structure (Figure 2, middle) resulted in excellent fit ($\chi^2 = .60$, $df = 1$, $p = .438$, RMSEA $= 0$/CI 0–.109, CFI $= 1$, SRMR $= .0036$, BIC $= -5.589$). The single-factor structure (Figure 2, bottom) resulted in poor fit ($\chi^2 = 108.2$, $df = 2$, $p < .0005$, RMSEA $= .330$/CI .279–.385, CFI $= .884$, SRMR $= .082$, BIC $= 95.777$) but could be improved by adding a covariation constraint between either word and pseudoword accuracy or word and pseudoword fluency, in which case it became equivalent to the accuracy-fluency model but with lower loadings of the error-covarying reading measures onto the single factor. No comparable improvement could be achieved by adding a covariation between word accuracy and fluency or between pseudoword accuracy and fluency, in which case it became equivalent to the word-nonword model.

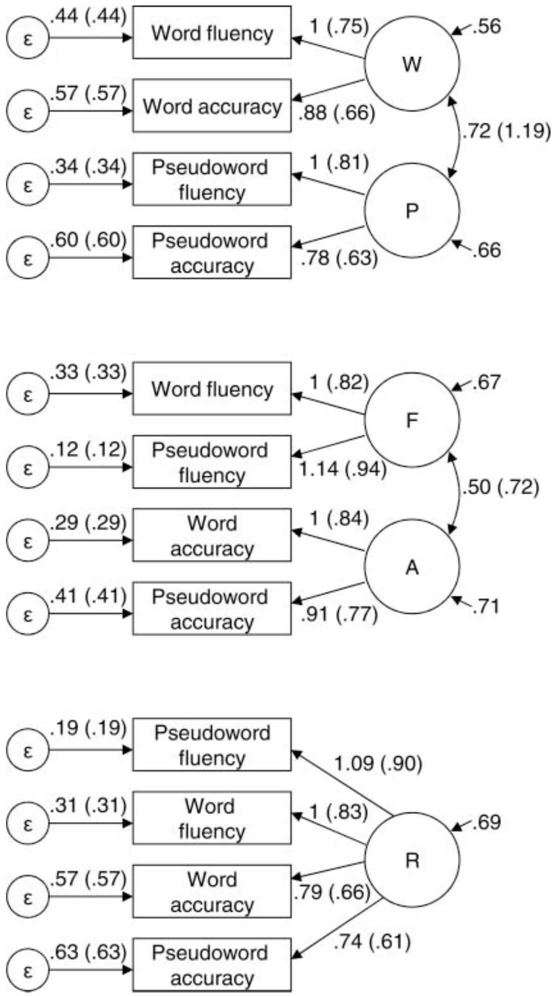

FIGURE 2 Measurement models for print-dependent measures. W = words, P = pseudowords, A = accuracy, F = fluency, R = reading. Unstandardized coefficients (and standardized coefficients, in parentheses).

Print-Independent Component

Two alternative structures of the print-independent component were examined, illustrated in Figure 3 along with corresponding standardized coefficients. The listening-vocabulary structure (Figure 3, top) resulted in excellent fit ($\chi^2 = .139$, $df = 1$, $p =$

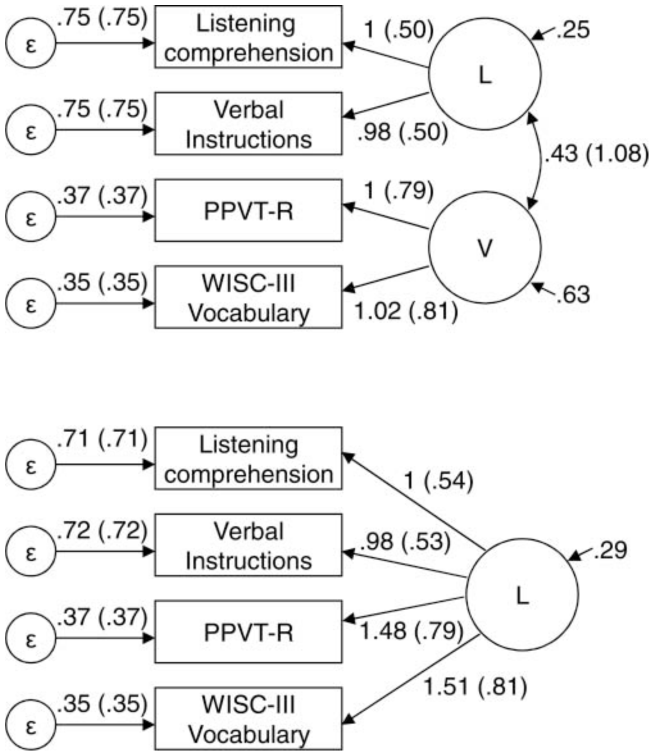

FIGURE 3 Measurement models for print-independent measures. L = language, V = vocabulary. Unstandardized coefficients (and standardized coefficients, in parentheses).

.709, RMSEA = 0/CI 0–.087, CFI = 1, SRMR = .0028, BIC = −6.051), but the standardized covariation coefficient between the two latent variables exceeded unity, indicating overparameterization. The single-factor structure (Figure 3, bottom) also resulted in excellent fit ($\chi^2 = 1.507$, $df = 2$, $p = .471$, RMSEA = 0/CI 0–.083, CFI = 1, SRMR = .0116, BIC = −10.874), not significantly different from the two-factor structure (Wald test: $\chi^2 = 1.367$, $df = 1$, $p = .242$), confirming the redundancy of the second factor. Importantly, error variance of the indicators did not increase after collapsing the two latent variables, confirming that there was no loss of explanatory variance going into the latent construct.

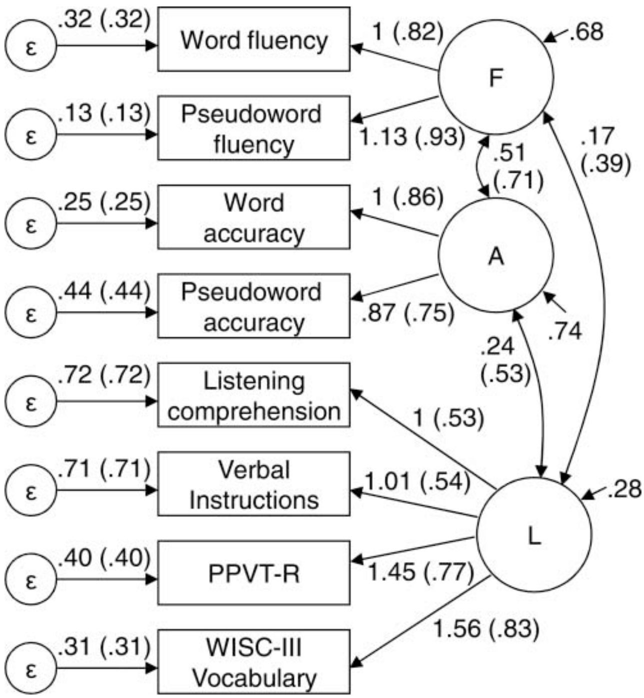

FIGURE 4 Measurement models for all measures modeled together. Unstandardized coefficients (and standardized coefficients, in parentheses).

Associations Among the Components

Figure 4 shows the model including all measures, with three latent factors as indicated by the preceding analyses. The fit of this model was satisfactory ($\chi^2 = 25.97$, $df = 17$, $p = .075$, RMSEA $= .033$/CI 0–.057, CFI $= .994$, SRMR $= .028$, BIC $= -79.263$). The maximum absolute normalized residual was 1.51. Examination of the modification indices suggested that cross-loadings of indicators on latent factors might improve the model fit somewhat; however, this option was not taken for reasons of theoretical parsimony.

Discussion

The purpose of the analyses presented here was to examine patterns of covariance among measures typically included in the evaluation of the simple view of reading, in order to determine appropriate groupings among measures into factors that can then be used to account for reading comprehension variance. The results lead to clear conclusions regarding both components of the simple view.

The Print-Dependent Component

With respect to the print-dependent component, our results suggest that at least for Greek children in Grades 3–5, word and nonword reading are not separable skills and can be readily combined into performance factors accounting for substantial amounts of measured variance as indicated by the high loadings. In contrast, reading accuracy and fluency measures constitute distinct dimensions of word-level reading skill and cannot be combined into a single word-reading factor. This finding is in agreement with results reported previously for Greek children in Grade 7 (Protopapas & Skaloumbakas, 2007) and Grades 3–4 (Protopapas & Skaloumbakas, 2008), using different assessment instruments than those used in the present study, in unrelated samples of the general student population. Those studies also showed that there are two dimensions of word-level reading skill, one concerning primarily reading accuracy and the other being aligned with reading speed, each encompassing performance with pseudowords, isolated words, and connected text, with very high intercorrelations among the types of reading material.

Protopapas and Skaloumbakas (2008) identified only one potential distinction between nonword and word reading skill, and only in the younger age group (Grades 3–4). Using raw speed measures (rather than the typical fluency indices calculated by taking into account only items pronounced correctly), they found that nonword reading exhibited a higher dissociation between speed and accuracy. They hypothesized that this pattern reflected the expression of two potential underlying strategies, one focusing on accurate reading, at the cost of lower speed, while the other emphasized rapid processing of the material, allowing occasional mistakes. This may be related to the distinction between "guessers" and "spellers" among children with poor reading skill (van der Schoot, Licht, Jorsley, & Sergeant, 2000). This pattern was seen only for nonwords and not in real word reading, either isolated or in text, without greatly diminishing the high correlation among word and nonword reading.

Reading fluency has not typically been included in investigations within the framework of the simple view. Prominent (and contradictory) exceptions include Adlof et al. (2006), who found neither concurrent nor longitudinal contribution of fluency to reading comprehension in Grades 2–8, and Tilstra et al. (2009), who reported unique concurrent contributions in Grades 4, 7, and 9. Further strong associations between fluency measures and reading comprehension have been reported, depending on the types of testing materials (e.g., Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003a, 2003b; Riedel, 2007). Discussing these and other related findings in a wider context, Fuchs, Fuchs, Hosp, and Jenkins (2001) highlighted the potential importance of fluency measures in the assessment of reading competence, including comprehension. More recently, researchers have examined alternative measures of reading fluency in accounting for reading comprehension variance (Wise, Sevcik, & Morris, 2008; see also Kuhn, Schwanenflugel, & Meisinger, 2010), warranting further investigation of the role of fluency in reading comprehension, as a separate print-dependent component within the context of the simple view.

The Print-Independent Component

Turning to the print-independent component, vocabulary measures were found to group with listening comprehension measures into a single language factor, as might be expected by the oral nature of their administration, in agreement with Kendeou, van den Broek et al. (2009). The excellent fit of the single-factor model indicates that there is no systematic variance shared among the two vocabulary measures that is separate from variance shared among the two listening comprehension measures. This may explain why vocabulary measures, being more reliable overall, end up taking up additional reading comprehension variance after listening comprehension is accounted for (Braze et al., 2007; Ouellette & Beers, 2010). That is, in terms of the simple view, perhaps vocabulary is not an additional skill to explain reading comprehension with, but a better indicator of the print-independent component than oral comprehension.

This supposition is not intended as a theoretical statement regarding the nature of underlying cognitive processes, but a statement about statistical patterns of covariance. It is not claimed that vocabulary measures capture every individual skill domain that goes into the construct of reading comprehension. Rather, vocabulary might act as a proxy for reading comprehension because of their extensive shared variance. Similarly, WISC Vocabulary is often used as a convenient shortcut to estimate verbal IQ (VIQ), because the vocabulary subscale happens to correlate very strongly with the VIQ scale total, even though no one would claim that vocabulary captures all the relevant facets of verbal IQ. In both cases, the nature of the observed shared variance remains to be investigated, and it may have to do with construct validity and measurement more than it has to do with theory.

The measurement issue, related to the estimated reliability of the measures, is difficult to disentangle from the conceptual issue, related to the constructs of "lexical knowledge" and "oral comprehension," on the basis of the available data. Our available measures of oral comprehension are of moderate or unknown internal consistency. Their elevated error coefficients in the well-fitting model indicate that most of their variance is either unreliable or not shared, raising a construct validity issue for the corresponding latent variable. This may be relatively common for measures of this type, so it seems increasingly important to report relevant indices of reliability both in research and in testing instruments. More reliable measures of listening comprehension will be required, as well as additional indicators with high face validity, at least for the language comprehension construct, before the alignment of vocabulary with oral comprehension can be definitively ascertained.

Associations Among the Two Components

The nonnegligible association between the print-dependent and the print-independent components suggests that their putative dissociation may have been overemphasized, or that it may be less readily applicable to more transparent orthographic systems. Not only was vocabulary significantly correlated with word and nonword reading accuracy and fluency, but there were also significant covariations at the latent level, suggesting that oral comprehension in general is strongly related to basic (word-level) reading skills. The conceptualization of the simple view as composed of two partially independent components does not naturally lend itself to accommodating these strong correlations. However, it should be noted that there is no fundamental theoretical incompatibility in allowing a significant covariation among the components. It might be possible to account for the between-component associations via Matthew effects reciprocally affecting word-level reading as well as reading comprehension. This is an issue worth investigating in the complete longitudinal data set from which our data were derived.

On the other hand, strong associations among the two components are naturally accommodated by views emphasizing the inherent relationship between knowing a word (as semantic knowledge) and recognizing its written form (as orthographic knowledge) (see, e.g., Nation, 2008). The emphasis on ties among, rather than distinctions between, constructs is a characteristic of the lexical quality hypothesis (Perfetti & Hart, 2001, 2002) for reading comprehension. In this framework, semantic, orthographic, and phonological representations together make up lexical skill and jointly contribute to comprehension, be it oral or reading. In this conceptualization, vocabulary may be an index of overall lexical skill, and thereby of comprehension (Protopapas et al., 2007), rather than simply a measure of word knowledge.

Limitations and Conclusions

The data analyzed in this study were collected from Greek-speaking children in Grades 3–5. There are limitations to interpretation arising from this special sample, related to age and orthographic transparency. In the context of the simple view it is typically found that comprehension is more strongly related to word reading skills in early grades but less so in later grades, being gradually supplanted by oral comprehension skills (Sénéchal et al., 2006). Vocabulary, in particular, seems to have increasing effects on reading comprehension at later grades (Storch & Whitehurst, 2002; Verhoeven & van Leeuwe, 2008), a pattern also seen for Greek (Protopapas et al., 2007). Taking into account that reading development in Greek appears to be accelerated relative to

English (Seymour, Aro, & Erskine, 2003), presumably due to the higher orthographic transparency of Greek, it seems that a comparable sample from English-speaking children might be seen in grades higher than 3–5, which made up our present sample. Therefore, our data are not directly comparable to data from English children obtained in the early or middle elementary grades and cannot be taken to support or refute any theoretical statements regarding early reading development in English. Furthermore, it remains to be seen whether orthographic transparency affects the general applicability of both the simple view and the lexical quality hypothesis.

In conclusion, our findings indicate that there are two factors of basic word-level reading skill that may be relevant for capturing reading comprehension variance through the print-dependent component, and that the dividing line does not lie between words and nonwords but between accuracy and fluency. We also found that, for the range of tests we employed, vocabulary groups perfectly with listening comprehension and may best be thought of as an indicator for the print-independent component rather than an additional skill dimension. Finally, the significant covariation among the print-dependent and print-independent measures must temper any strong claims for dissociability and independence. Our study did not attempt to model reading comprehension variance and to account for it via the component measures, but only to test the coherence of the component constructs themselves on the basis of indicators typically employed to assess them. It remains to be investigated in future studies whether the derived components indeed account for reading comprehension variance in a parsimonious manner, and what additional measures will be required in order to fully capture all systematic comprehension variance.

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