

Abstract

Objective

This investigation examined the structural relations among latent variables of language, decoding, and reading comprehension and patterns of predictions over two years in grade cohorts 5 to 6, 7 to 8, and 9 to 10.

Longitudinal studies have shown that language skills from early childhood predict reading comprehension at the end of elementary school (Catts, Herrera, Nielsen, & Bridges, 2015; Muter, Hulme, Snowling, & Stevenson, 2004; Storch & Whitehurst, 2002; Verhoeven & Van Leeuwe, 2008). Results from recent studies disagree on the extent to which the pathways for decoding and language diverge in elementary school. Researchers from the Language and Reading Research Consortium (LARRC) found that preschool oral language predicted reading comprehension in grade 3 via listening comprehension but that the developmental pathways of decoding and listening comprehension were independent (LARCC & Chiu, 2018). In contrast, Lonigan and colleagues found developmental trends in the significance of language and decoding but that substantial overlap existed in their prediction of reading comprehension in grades 3–5 (Lonigan, Burgess, & Schatschneider, 2018). In a cross-sectional study, Foorman, Petscher, and Herrera (2018) also found substantial overlap as early as the primary grades and that by grade 10 language and reading comprehension were essentially the same dimension.

A longitudinal investigation of the developmental shifts in the structure of decoding and language constructs as they predict reading comprehension above the elementary grades is needed.

Method

Participants were 321 students in grade 5 in six elementary schools, 263 students in grade 7 in six middle schools, and 137 students in grades 9 in one high school in Florida. The percentage of students participating in the Federal Lunch Program in the 13 schools ranged from 20.63% to 100%, with a median of 61.86%. Across the three cohorts, students were half or mostly female (55.1%, 51.3% and 65.0%, respectively). In the grade 5 cohort, the demographics were: 27.5% White, 26.4% Hispanic, 35.2% Black, 6.2% Asian, 4.1% Multiracial, and 0.5% Other. In the grade 7 cohort, the demographics were: 34.4% White, 46.7% Hispanic, 11.7% Black, 4.4% Asian, and 2.8% Multiracial. In the grade 9 cohort, the demographics were: 49.1% White, 25.9% Hispanic, 9.8% Black, 6.3% Asian, 8.0% Multiracial, and 0.9% Other.

The same language, decoding, and reading comprehension measures were administered to the three cohorts of students as part of a planned missing data design (Table 1). Scale scores for each test were used for analysis (see correlations and descriptive statistics in Table 2). Multiple measures of each construct were given in order to produce latent factors. Language and decoding were measured in Year 1, reading comprehension was measured in Year 2.

Syntax measures were: Recalling Sentences (RS) subtest of the Clinical Evaluation of Language Fundamentals–4 (CELF-4; Semel, Wiig, & Secord, 2003) and the Grammaticality Judgment subtest (GJT) of the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 2008). The vocabulary measure was the Peabody Picture Vocabulary Test–4 (PPVT–4; Dunn & Dunn, 2007). Decoding fluency was measured with the Test of Word Reading Efficiency–2 (TOWRE–2; Wagner, Torgesen, & Rashotte, 2012). Reading comprehension was measured with the Gates-MacGinitie Reading Test–4 (GMRT–4; MacGinitie, MacGinitie, Maria, & Dreyer, 2000) and the Florida Comprehensive Assessment Test 2.0 Reading (FCAT 2.0; Florida Department of Education, 2013), both of which consist of literacy and informational passages and multiple-choice questions. .

The dimensionality of language measures (vocabulary and syntax) and decoding measures (real word and nonword fluency) was examined using confirmatory factor analysis and related to a reading comprehension factor consisting of state and national tests. All three factors were fit in one model for each cohort separately, such that decoding and language in Year 1 and reading comprehension in Year 2 were inter-correlated using the data from the grades 5, 7, and 9 cohorts (Figure 1). Structural equation models (SEM) were used to estimate the relations of Year 1 decoding and Year 1 language to Year 2 reading comprehension.

Results

Due to the planned missing data design, data were missing completely at random (MCAR) and MCAR was confirmed across cohorts, demographics, and years. Structural relations among language, decoding, and reading comprehension were stable across grade cohorts (Table 5). Partial scalar invariance allowed results to be compared across cohorts (Table 6).

The striking finding was the changing role of language with respect to decoding in predicting reading comprehension one year later. In the grade 5 cohort, grade 5 decoding significantly predicted grade 6 reading comprehension above and beyond the contribution of grade 5 language. In the grade 7 cohort, however, the effect of grade 7 language on grade 8 reading comprehension was larger, and the effect of grade 7 decoding on grade 8 reading comprehension was smaller than in the grade 5 cohort. In fact, grade 7 decoding significantly predicted grade 8 reading comprehension only when the effect of grade 7 language on grade 8 reading comprehension was controlled. In the high school cohort, grade 9 decoding no longer significantly predicted grade 10 reading comprehension and grade 9 language nearly perfectly predicted grade 10 reading comprehension.

Conclusion

This study provides longitudinal support to the authors' cross-sectional findings of the increasing importance of language over decoding to predicting reading comprehension in secondary school (Foorman et al., 2015; Foorman et al., 2018). The contribution of language to the prediction of reading comprehension in upper elementary school also supports findings of other researchers (Kieffer et al., 2016; Lonigan et al., 2018, Protopapas et al., 2013).

The main message educational implication is the importance of oral language to understanding written language. Both language and decoding are potential malleable factors for intervention in upper elementary school (Wanzek, Wexler, Vaughn, & Cuillo, 2010); however, language must be a target of reading intervention even earlier if students are to read with understanding. School readiness must accelerate all children's oral language skills so that when coupled with phonological and alphabetic skills, primary-grade child can successfully access the meaning of text (Bornstein, Hahn, Putnick, & Suwalsky, 2014; Castles, Rastle, & Nation, 2018; Foorman, Beyler, et al., 2016; LARRC, 2015).

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Table 1

Planned Missing Data Design by Construct, Measure, Grade, and Year

Construct/Measures	Grade 5 Cohort					Grade 7 Cohort				Grade 9 Cohort			
	Year	N	Form A	Form B	Form C	N	Form A	Form B	Form C	N	Form A	Form B	Form C
Language													
CELF RS	1	213		X	X	199		X	X	90		X	X
CASL GJT	1	210	X		X	196	X		X	80	X		X
PPVT	1	207	X		X	198	X		X	84	X		X
Decoding													
TOWRE TRA	1	210	X		X	199		X	X	90		X	X
TOWRE TRB	1	210	X		X	199		X	X	90		X	X
TOWRE TNA	1	210	X		X	199		X	X	90		X	X
TOWRE TNB	1	210	X		X	199		X	X	90		X	X
Reading Comprehension													
FCAT	2	201	X	X	X	220	X	X	X	115	X	X	X
GMRT	2	92	X	X	X	97	X	X	X	56	X	X	X

CELF = Clinical Evaluation of Language Fundamentals, 4th ed. (RS = Recalling Sentences); CASL = Comprehensive Assessment of Spoken Language (GJT = Grammatical Judgment subtest); PPVT = Peabody Picture Vocabulary Test, 4th ed.; SARA = Study Aid and Reading Assessment (VOC = Vocabulary; MORPH = Morphological Awareness); TOWRE = Test of Word Reading Efficiency (TR = Sight Word Efficiency; TN = Phonemic Decoding Efficiency; A = Form A; B = Form B); FCAT = Florida Comprehensive Assessment Test; GMRT = Gates-MacGinitie Reading Test.

Table 2

Summary of Correlations and Descriptive Statistics for Grade 5 Cohort

		1	2	3	4	5	6	7	8	9
Language										
1. G5 CELF RS		1.00								
2. G5 CASL GJT		.67	1.00							
3. G5 PPVT		.54	.73	1.00						
Decoding										
4. G5 TOWRE TRA		.45	.47	.40	1.00					
5. G5 TOWRE TRB		.47	.49	.43	.92	1.00				
6. G5 TOWRE TNA		.43	.45	.37	.77	.76	1.00			
7. G5 TOWRE TNB		.45	.45	.38	.77	.77	.93	1.00		
Reading Comprehension										
8. G6 FCAT		.59	.65	.72	.51	.54	.51	.53	1.00	
9. G6 GMRT		.52	.63	.62	.44	.46	.47	.48	.83	1.00
Descriptive Statistics										
<i>n</i>		213	210	207	210	210	210	210	201	92
Min.		23	40	45	11	7	3	5	167	420
Max		88	125	146	104	97	63	65	283	583
Mean		61.38	91.50	99.16	71.60	71.72	38.58	39.10	227.97	507.12
SD		12.69	13.45	15.82	12.29	11.91	12.29	12.58	20.66	33.93

Note. All correlations are significant at the 0.01 level (2-tailed). G5 = Grade 5; G6 = Grade 6. CELF = Clinical Evaluation of Language Fundamentals, 4th ed. (RS = Recalling Sentences); CASL = Comprehensive Assessment of Spoken Language (GJT = Grammatical Judgment subtest); PPVT = Peabody Picture Vocabulary Test, 4th ed.; SARA = Study Aid and Reading Assessment (VOC = Vocabulary; MORPH = Morphological Awareness); TOWRE = Test of Word Reading Efficiency (TR = Sight Word Efficiency; TN = Phonemic Decoding Efficiency; A = Form A; B = Form B); FCAT = Florida Comprehensive Assessment Test; GMRT = Gates-MacGinitie Reading Test.

Table 3

Summary of Correlations and Descriptive Statistics for Grade 7 Cohort

		1	2	3	4	5	6	7	8	9
Language										
1. G7 CELF RS		1								
2. G7 CASL GJT		0.64	1							
3. G7 PPVT		0.62	0.65	1						
Decoding										
4. G7 TOWRE TRA		0.41	0.34	0.37	1					
5. G7 TOWRE TRB		0.41	0.28	0.36	0.91	1				
6. G7 TOWRE TNA		0.32	0.23	0.27	0.73	0.74	1			
7. G7 TOWRE TNB		0.30	0.26	0.24	0.73	0.74	0.90	1		
Reading Comprehension										
8. G8 FCAT		0.60	0.59	0.66	0.44	0.42	0.31	0.34	1	
9. G8 GMRT		0.45	0.39	0.60	0.30	0.28	0.27	0.19	0.68	1
Descriptive Statistics										
<i>n</i>		199	196	198	199	199	199	199	220	97
Min.		22	40	37	31	34	12	8	178	463
Max		93	149	135	108	103	64	65	296	660
Mean		66.3	89.4	96.4	75.7	74.8	41.5	41.5	236.3	539.4
<i>n</i>		2	6	1	8	7	4	7	0	6
SD		14.8	13.6	16.0	11.4	11.0	11.8	12.1	21.46	35.23
		5	5	2	8	6	4	6		

Note. All correlations are significant at the 0.01 level (2-tailed). G7 = Grade 7; G8 = Grade 8. CELF = Clinical Evaluation of Language Fundamentals, 4th ed. (RS = Recalling Sentences); CASL = Comprehensive Assessment of Spoken Language (GJT = Grammatical Judgment subtest); PPVT = Peabody Picture Vocabulary Test, 4th ed.; SARA = Study Aid and Reading Assessment (VOC = Vocabulary; MORPH = Morphological Awareness); TOWRE = Test of Word Reading Efficiency (TR = Sight Word Efficiency; TN = Phonemic Decoding Efficiency; A = Form A; B = Form B); FCAT = Florida Comprehensive Assessment Test; GMRT = Gates-MacGinitie Reading Test.

Table 4

Summary of Correlations and Descriptive Statistics for Grade 9 Cohort

		1	2	3	6	7	8	9	11	13
Language										
1. G9 CELF RS		1								
2. G9 CASL GJT		0.72	1							
3. G9 PPVT 9		0.63	0.74	1						
Decoding										
6. G9 TOWRE TRA		0.29	0.54	0.45	1					
7. G9 TOWRE TRB		0.32	0.55	0.43	0.91	1				
8. G9 TOWRE TNA		0.18	0.37	0.33	0.65	0.76	1			
9. G9 TOWRE TNB		0.22	0.46	0.40	0.67	0.77	0.94	1		
Reading Comprehension										
11. G10 FCAT		0.52	0.70	0.82	0.43	0.43	0.45	0.54	1	
13. G10 GMRT		0.50	0.70	0.74	0.24	0.24	0.24	0.35	0.71	1
Original Data										
	<i>n</i>	90	80	84	90	90	90	90	115	56
	Min.	43	56	69	54	54	16	19	202	515
	Max	95	109	129	106	106	66	66	302	617
	.									
	Mea	77.8	92.9	103.8	84.6	84.1	47.8	48.6	257.2	569.9
	n	4	4	2	6	9	9	8	6	1
	SD	11.4	10.3	13.27	9.88	10.6	11.1	11.0	18.45	21.93
		0	3			1	6	1		

Note. All correlations are significant at the 0.01 level (2-tailed). G9 = Grade 9; G10 = Grade 10. CELF = Clinical Evaluation of Language Fundamentals, 4th ed. (RS = Recalling Sentences); CASL = Comprehensive Assessment of Spoken Language (GJT = Grammatical Judgment subtest); PPVT = Peabody Picture Vocabulary Test, 4th ed.; SARA = Study Aid and Reading Assessment (VOC = Vocabulary; MORPH = Morphological Awareness); TOWRE = Test of Word Reading Efficiency (TR = Sight Word Efficiency; TN = Phonemic Decoding Efficiency; A = Form A; B = Form B); FCAT = Florida Comprehensive Assessment Test; GMRT = Gates-MacGinitie Reading Test.

Table 5

Model fit indices for the CFAs and SEMs by cohort

CFA Models	n	X ²	df	p-value	SCF	RMSEA	90% CI	CFI	TLI
G56 (Cohort 1)	213	24.31	22	.331	1.02	.02	.00 - .05	.99	.99
G78 (Cohort 2)	220	22.55	22	.427	1.03	.01	.00 - .05	.99	.99
G910 (Cohort 3) ^a	115	80.06	22	< .001	0.61	.14	.11 - .17	.92	.92
SEMs									
G56 (Cohort 1)	213	24.31	22	.331	1.02	.02	.00 - .05	.99	.99
G78 (Cohort 2)	220	22.55	22	.427	1.03	.01	.00 - .05	.99	.99
G910 (Cohort 3) ^a	115	64.31	23	< .001	0.76	.11	.08 - .15	.94	.94

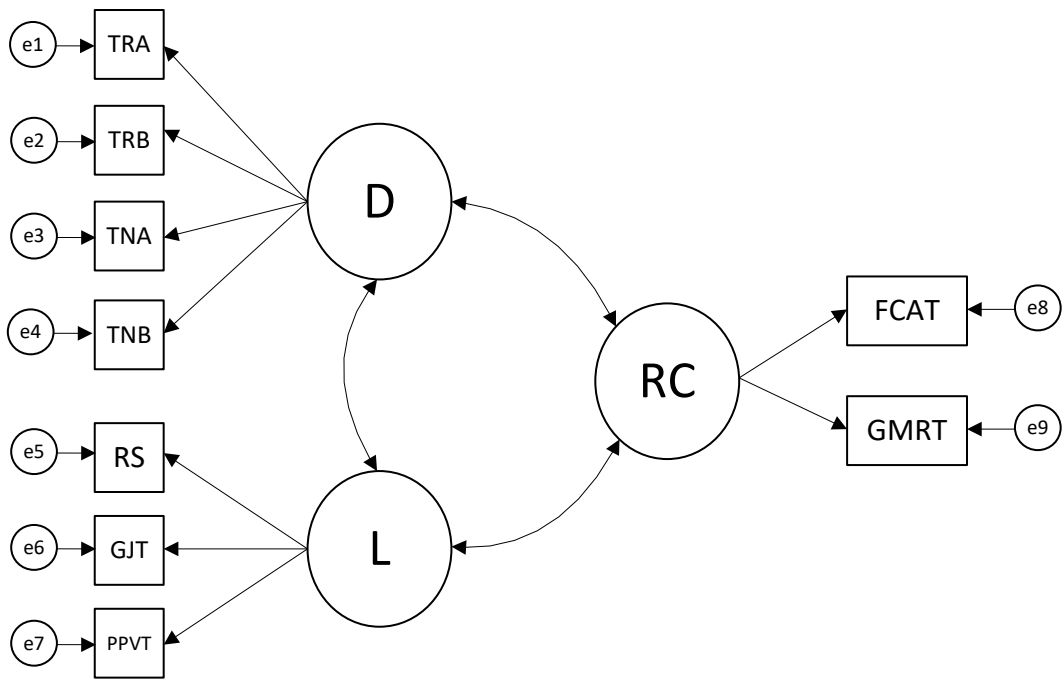
Note. SCF = Scaling correct factor for MLR; RMSEA = root-mean squared error of approximation; CFI = Confirmatory Fix Index; TLI = Tucker-Lewis Index. ^a= Model fits are different between the CFA and SEM for this cohort because of multicollinearity in estimating the covariance between the language and reading comprehension factor. In the SEM, this multicollinearity was addressed by allowing decoding and language to predict reading comprehension and fixing the residual variance of the reading comprehension factor to zero.

Table 6

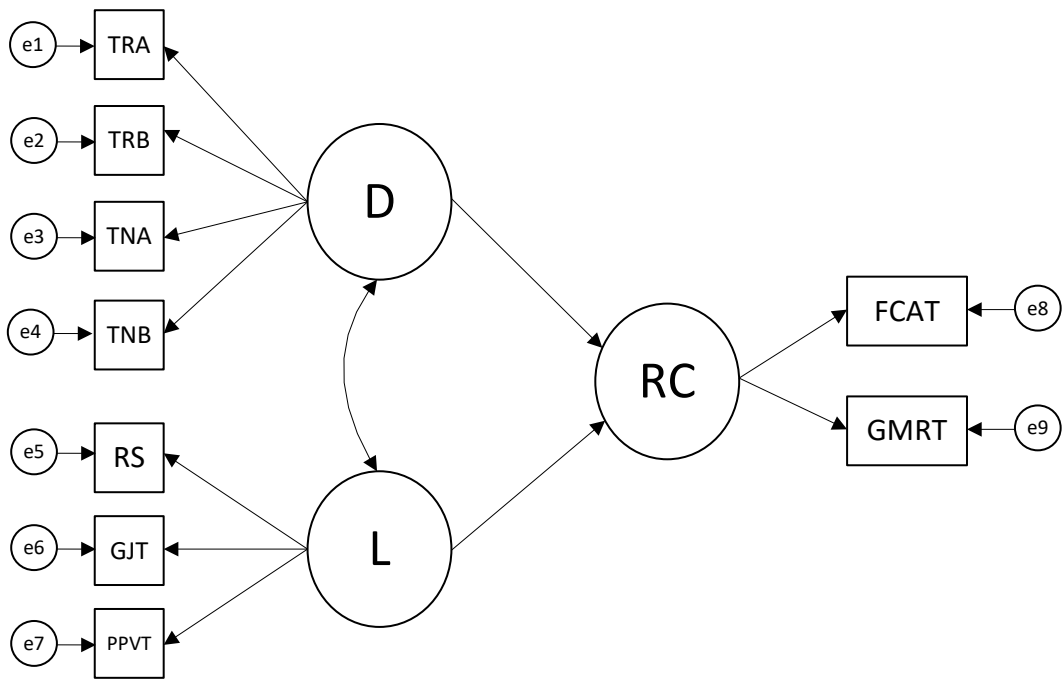
Model Fit Indices for the Invariance Model Testing

	χ^2	<i>df</i>	<i>p</i>	SC <i>F</i>	CFI	TLI	RMS EA	90% CI	BIC
Strict	263.	10	<.00						
	58	0	1	1.02	.95	.94	.08	.07 - .09	31446.76
Scalar	253.		<.00						
	56	98	1	1.03	.95	.95	.08	.07 - .09	31444.88
Partial Scalar	171.		<.00						
	08	93	1	1.03	.98	.97	.06	.04 - .07	31378.01

Note. Configural Model and Metric Model did not converge. Df = degrees of freedom; SCF = scaling correction factor for Satorra-Bentler chi-square difference testing; CFI = Confirmatory Fit Index; TLI = Tucker Lewis Index; RMSEA = root mean squared error of approximation.

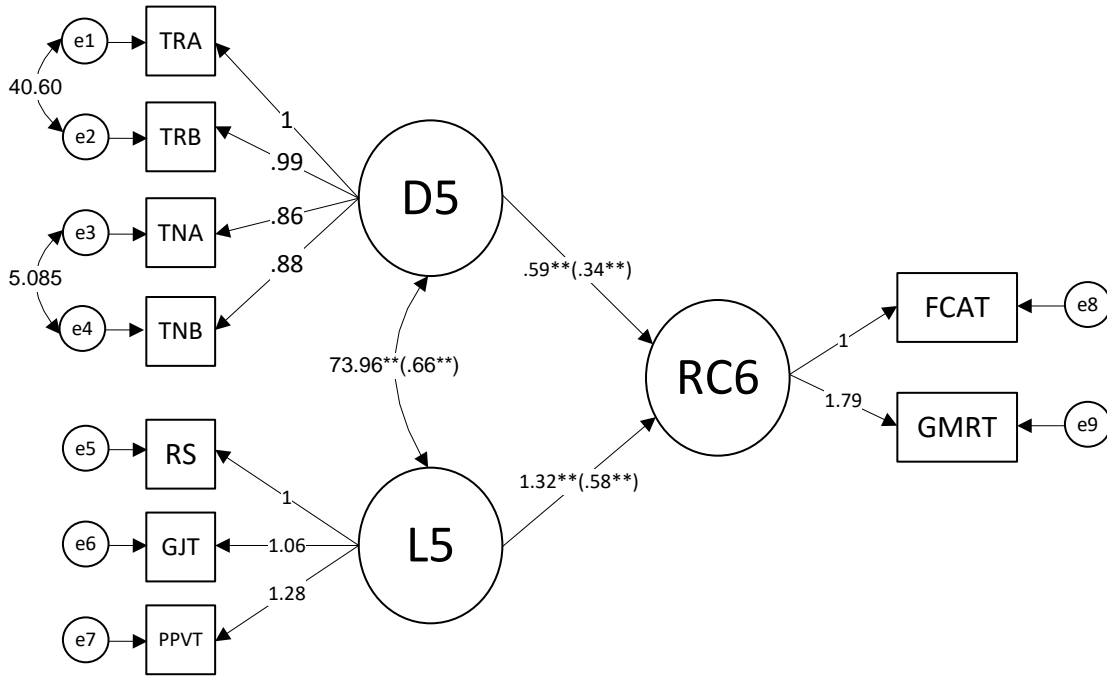


(a)

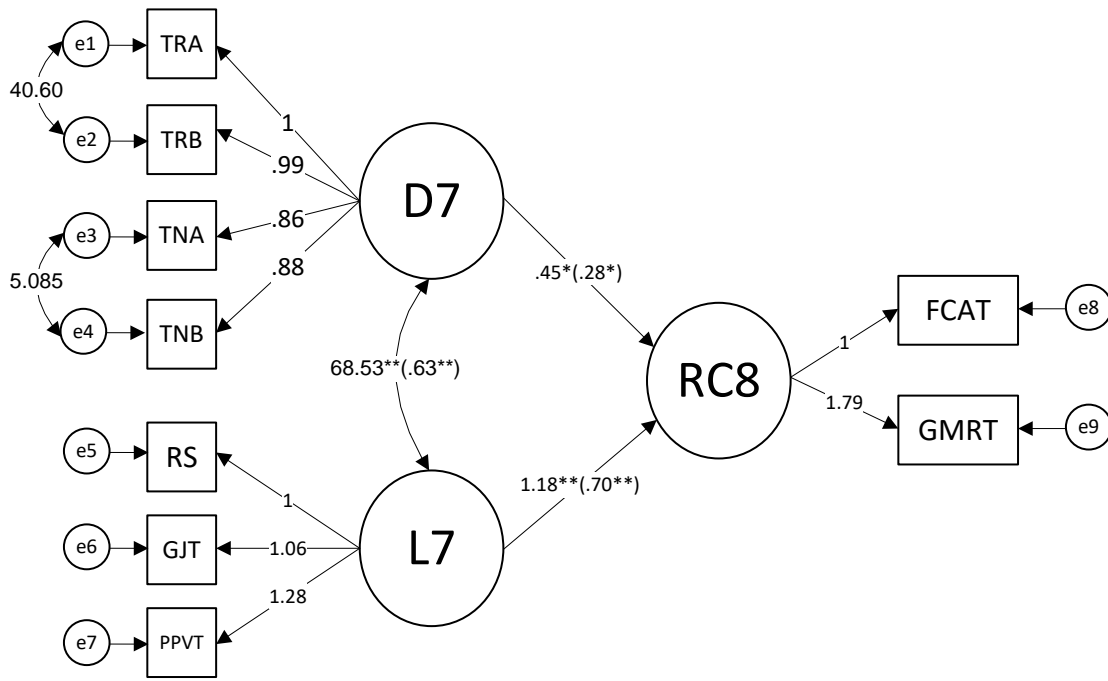


(b)

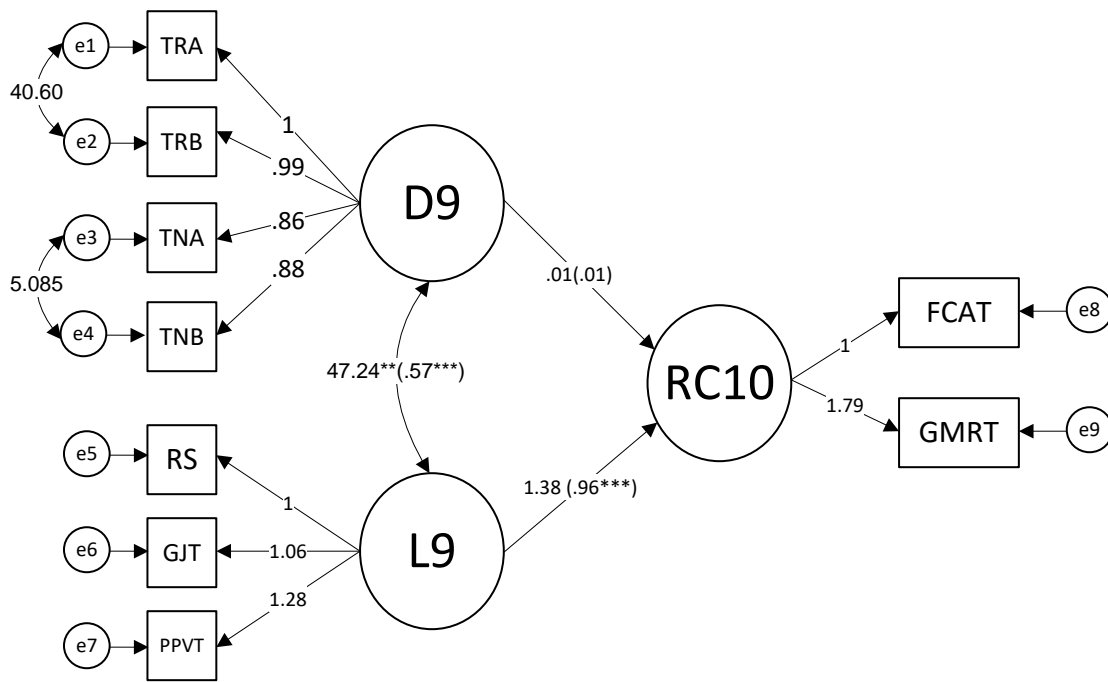
Figure 1. CFA (a) and SEM (b) fit to the data for language, decoding, and reading comprehension across the three cohorts. The SEM in (b) changes the covariances between D and RC and between L and RC to instead be direct pathways as a test of time precedence. TRA = TOWRE Sight Word Efficiency Form A; TRB = TOWRE Sight Word Efficiency Form B; TNA = TOWRE Phonemic Decoding Efficiency Form A; TNA = TOWRE Phonemic Decoding Efficiency Form B; RS = CELF Recalling Sentences; GJT = CASL Grammatical Judgment; PPVT = Peabody Picture Vocabulary Test; FCAT = Florida Comprehensive Assessment Test; GMRT = Gates-MacGinitie Reading Test.



(a)



(b)



(c)

*Figure 2. Diagram of the Partially Invariant SEM of Language and Decoding in the Prediction of Reading Comprehension in Grade 5/6 (a), Grade 7/8 (b), and Grade 9/10 (c). Factor loadings and residual covariances are presented as unstandardized estimates. Factor covariances and regression pathways are presented as unstandardized estimates with standardized estimates in parentheses. * = $p < .05$; ** = $p < .01$; *** = $p < .001$.*