A Not-So-Simple View of Adolescent Writing

Apryl L. Poch
Duquesne University

Erica S. Lembke
University of Missouri

Abstract

According to the Simple View of Writing, four primary skills are necessary for successful writing (Berninger & Amtmann, 2003; Berninger & Winn, 2006). Transcription skills (e.g., handwriting, spelling) represent lower-order cognitive tasks, whereas text generation skills (e.g., ideation, translation) represent higher-order writing/cognitive abilities. Self-regulatory executive functions include the attentional and regulatory abilities that help manage the writing process, and working memory represents the cognitive complexity of the writing process. Exploratory factor analysis was used to explore the relations amongst the components of the Simple View of Writing. A one-way ANOVA tested for differences between struggling and non-struggling writers on the observed variables. Results revealed a two-factor model, suggesting writing is more multidimensional. Statistically significant differences were observed between struggling and non-struggling writers on all measures except the Behavior Rating Inventory of Executive Function – Self-Report and the Graphic Speed task of the Detailed Assessment of Speed of Handwriting.

Keywords: Writing, Simple View of Writing, Adolescents

Successfully coordinating the processes of writing is complex, as many researchers have scientifically modeled (see Graham, 2006, for a review). Writing models themselves also have varying degrees of complexity (e.g., Berninger, Mizokawa, & Bragg, 1991; Berninger & Winn, 2006; Hayes, 1996; Hayes & Flower, 1980). However, according to Hayes (1996), modeling often relies on incomplete parts from which more specific models can be built; even Graham (2006) refers to the models he reviews as incomplete. Thus, further modeling offers promise for creating a richer, more nuanced understanding of writing (Graham, 2006).

Following upon Hayes and Flower's (1980) pinnacle processing model of writing and its subsequent revisions, the Simple View of Writing (SVW) has more recently become a prominent developmental writing model. Early conceptions of the SVW postulated that writing is the product of two processes – the lower-order skill of spelling and the higher-order skill of ideation (Juel, Griffith, & Gough, 1986).

Later work by Berninger and colleagues to understand beginning and developing writing (e.g., Berninger & Swanson, 1994; Berninger et al., 1991; Berninger, Whitaker, & Swanson, 1992) also resulted in a SVW model (see Berninger & Amtmann, 2003; Berninger et al., 2002). Berninger and colleagues represented their model as a triangle, with transcription and self-regulatory executive functions (EF) serving as the base and text generation posited as the "vertex" (Berninger & Amtmann, 2003, p. 349; Berninger et al., 2002, p. 292), with the entire structure situated within a working memory (WM) environment.

Using advancements in brain research and technology, Berninger and Winn (2006) updated the model, forming the "not-so-simple view of internal functional writing systems" (p. 97). This updated model retained the original components of the initial model, but provided greater clarity about the components of WM and self-regulatory EFs and suggested that long-term memory (LTM) is also activated during planning, reviewing, and

Poch, A. L., & Lembke, E. S. (2017). A Not-So-Simple View of Adolescent Writing. *International Journal for Research in Learning Disabilities, 3*(2), 27-44. https://doi.org/10.28987/ijrld.3.2.27

revising, and that short-term memory (STM) is activated during reviewing and revising.

This study drew on an understanding of the SVW from the work of Berninger and colleagues (Berninger & Amtmann, 2003; Berninger et al., 2002; Berninger & Winn, 2006). Swanson and Berninger's earlier work remains key literature in the field of writing for understanding relations between WM and STM, and text generation and transcription-related skills. When possible, more recent literature is cited, but with the dearth of literature related to secondary learners, earlier work is included to supplement and support hypothesized interactions.

Although the SVW remains a highly visible theoretical model across the elementary writing literature and occasionally at the middle school level, the model lacks specificity about the component skills necessary for text generation (Kim & Schatschneider, 2017) and the relations amongst the component skills at the high school level. Thus, this study sought to specifically address the current gap in the literature for the SVW as it relates to high school students, given the intractable and entrenched writing needs of adolescent struggling writers and the centrality of writing to postsecondary success. However, it is important first to understand how each of the components of the SVW contributes to the development of writing and the potential implications of these components for adolescent writers, because knowledge of and the relation(s) of the components may help researchers and teachers understand the challenges that adolescents are encountering in writing and can later be used to inform the development of corresponding instructional and intervention practices.

Component Skills of the SVW

The SVW consists of four primary components: transcription, self-regulatory EFs, text generation, and WM. Each is described below.

Transcription

According to the SVW model, students who spend a considerable portion of their writing time focusing on transcription (e.g., forming letters and spelling words) have fewer cognitive resources remaining to devote to higher-order processes like planning and ideation. The role of transcription skills in the production of writing (e.g., resulting in more fluent and detailed text and improved composition) is well supported at the elementary level (see Berninger, 1999; Berninger et al., 2002; Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Kim, Al Otaiba, Wanzek, & Gatlin, 2015; Wagner et al., 2011). However, the extent to which transcription skills continue to impact adolescent writers is unclear, even though transcription deficits are often a persistent struggle for individuals with learning disabilities well into the intermediary years (McCutchen, 1996, 2011), and the speed of writing is a direct effect/predictor of writing at age 16 (Dockrell, Lindsay, & Connelly, 2009), with handwriting fluency beginning to plateau around junior high for typically developing writers (Graham, Berninger, Weintraub, & Schafer, 1998).

Self-Regulatory EFs

Self-regulatory EFs are the other base of the SVW. According to Berninger and Amtmann (2003), EFs within the model include conscious attention, planning, reviewing, revising, and strategies for self-regulation. As a writer matures, the EFs that regulate processes shift from "other-regulation" (e.g., regulation offered via teachers, parents, and peers) to "self-regulation" (Berninger & Amtmann, 2003, p. 350). This transition is the result of both brain maturation and instruction (see also Berninger & Richards, 2002), suggesting that self-regulatory skills develop over time, including through adolescence (Effeney, Carroll, & Bahr, 2013).

Text Generation

Text generation, positioned as the vertex of the SVW model, draws on both ideation and the translation of those ideas into language representations (especially at the sentence and text/discourse level) in WM (Berninger et al., 2002). In an early study, Juel et al. (1986) described ideation as the generation and organization of ideas during writing. However, this dynamic, complex process of generating text remains largely underdeveloped in the literature, even at the elementary level (Kim & Schatschneider, 2017), where text generation is often posited as an outcome of the other components of the model, and said to be influenced by transcription skills (Abbot, Berninger,

& Fayol, 2010; Berninger et al., 2002), which, in turn, mediate the relationship between writing and WM – the final component of the model (Kim & Schatschneider, 2017). Even though recent research on the SVW has equated text generation with oral language skills (Kim & Schatschneider, 2017), it is unclear what Berninger and colleagues intended when they specified the model (e.g., Berninger & Amtmann, 2003). Thus, it is premature to assume that text generation is synonymous with oral language generation, though Berninger's work has continued to emphasize writing as foremost oral language representation.

WM

Within the SVW, WM is believed to constrain students' transcription, text generation, and self-regulation skills. According to Cowan (2014), WM may be defined as "the small amount of information that can be held in an especially accessible state and used in cognitive tasks" (p. 198; e.g., planning, comprehension, reasoning, and problem-solving). The writer is required to maintain a series of processes and information in mind as he/she actively creates text. Concepts from LTM must be accessed and stored in WM as the writer decides on what, why, and how to write (Swanson & Berninger, 1996); this continues to be important throughout planning, translating, reviewing, and revising (Berninger & Winn, 2006), with STM also central to the reviewing and revising processes. Thus, the interplay of transcription, self-regulatory EFs, and text generation – in involving LTM, STM, and WM – might result in cognitive capacity limitations, which can impact "the number of writing processes that the writer can manage simultaneously, but also the very nature of those processes" (McCutchen, 1996, p. 320).

Purpose of the Study

Although the SVW remains a highly visible and informative model, critical aspects of the model require additional support, especially if research is to invoke the SVW as an appropriate and rigorous theoretical model. Specifically, studies are needed to structurally evaluate the entire model and to evaluate it across the age span.

Building on the extant literature and the component structure of the SVW, this study took an integrated or holistic approach to assess the complete model (rather than the relationship between selected components) in order to explore the relations of the component skills at ninth grade, seeking to address a gap in the present research, which has primarily focused on beginning writing. That is, we sought to answer the question: Can a measurement model be fit to the data? If not, what is the factor structure of the data? A secondary aim of the study was to explore differences between struggling and non-struggling writers across the observed variables.

Method

Participants

Participants in this study included 69 ninth-grade students from a large suburban public high school in the midwestern United States (57% female; mean age = 14.38 years). All students were enrolled in one of five English classes taught by the same certified English teacher, who was in her second year of teaching. Three of the five classes included support from a certified special education teacher in his first year of teaching.

Consenting students represented a diverse sample: 57% White; 43% of another race (2.90% Asian, 18.84% Black, 13.04% Hispanic, and 8.70% Multiracial); and 49% received a free or reduced-price lunch. Two students (2.90%) received special education services, and one student (1.45%) received services under Section 504 of the Rehabilitation Act of 1973. No students were identified as English language learners. For students for whom state testing data were available, scores on the state assessment in Communication Arts (grades 3–7) or English Language Arts (grade 8) (range *n* = 42–58) revealed that 23.9–38.1% performed at or below basic, indicating incomplete command of grade-level skills.

Measures

Careful consideration was taken in selecting assessments for the study. As in much of the previous literature, standardized assessments were preferred. However, because this sample included ninth-grade students, age-appropriate assessments were necessary. Moreover, due to limitations in available instruments for assessing self-regulatory EFs (e.g., self-report questionnaires specific to writing, like Petrić and Czárl's 2003 scale, was not designed for adolescents) and WM (e.g., no longer available or used in previous studies with elementary-aged students), alternative measures had to be selected.

Nonetheless, all selected assessments were chosen because they captured performance in areas strongly related to the components of the SVW. In this study, transcription referred to spelling and handwriting, self-regulation was measured by a standardized self-report inventory of EF and the ability to plan before writing, text generation was assessed by a student's ability to generate text at the sentence and paragraph/essay level (i.e., written discourse), and WM was measured by the ability to recall a set of information in a particular sequence.

Spelling. The Spelling subtest of the *Wechsler Individual Achievement Test – III (WIAT-III*) (Wechsler, 2009) is a comprehensive, diagnostic standardized assessment of student academic achievement designed for children in grades pre-K through 12. The Spelling subtest contains 63 letter sounds/words ascending in difficulty. Letter sounds are presented to students in the context of a word; and each word is dictated orally, used in a sentence, and then stated again.

Unlike the standardized directions, all letter sounds/words were administered to students in medium-sized groups (11–16 students); basals and ceilings were scored later by the primary investigator. Age-based reliability coefficients for the Spelling subtest range from .95–.97 for students ages 13–16 (Breaux, 2009). The stability coefficient of the Spelling subtest is strong, with a corrected r of .92 (Breaux, 2009).

Handwriting. The *Detailed Assessment of Speed of Handwriting (DASH)* (Barnett, Henderson, Scheib, & Schulz, 2007a), a standardized handwriting assessment, was used to assess students' handwriting abilities. This assessment includes five subtests (Copy Best, Alphabet Writing, Copy Fast, Graphic Speed, and Free Writing) that evaluate different aspects of handwriting speed, including fine-motor and precision skills, quick and accurate production of well-known alphabetic symbols, the ability to vary handwriting speed, and free writing (Barnett, Henderson, Scheib, & Schulz, 2007b).

The Copy Best and Copy Fast subtests ask students to copy the familiar sentence "The quick brown fox jumps over the lazy dog" as quickly as possible in two minutes in their best and, later, in their fast handwriting. In the Alphabet Writing subtest, students write the letters of the alphabet in order in lowercase for one minute. During the Graphic Speed task, students make an X within a series of circles; the lines of the X must touch the smaller circle, but not exceed the larger circle. This task is timed for one minute, but is not used to derive the total standard score. The final task is a Free Writing essay on "My Life." Students can write on any topic of their life; they are provided with a filled-in graphic organizer to assist in thinking about relevant topics, but they are not limited to those topics. The task is timed for 10 minutes, with time markers every two minutes.

Inter-rater reliability is high across the Copy Best, Alphabet Writing, Copy Fast, and Free Writing tasks, with intra-class correlations greater than .99. Inter-rater reliability is much lower for the Graphic Speed task, with an intra-class correlation of .85. Total score test-retest reliability is above .80, with Spearman correlation coefficients of .72 (Copy Best), .75 (Copy Fast), .92 (Alphabet Writing), .87 (Free Writing), and .89 (Total Score) for a sample of students ages 14–15 years. Internal consistency of the DASH is high, with Cronbach alphas between .83 and .89 for students who are 13–15 years of age. Criterion validity with the Movement ABC-2 test administered concurrently reveals positive, but low correlations at or below .4 (Barnett et al., 2007b).

Writing measures. To generate student writing at the sentence level, the Sentence Composition subtest of the WIAT-III (Wechsler, 2009), which includes Sentence Building and Sentence Combining, was administered. The Sentence Building task requires students to generate a complete sentence that correctly uses the target word in context. The Sentence Combining task requires students to accurately combine two or three target sentences into one sentence that includes the essential information from the target sentences while maintaining the same meaning.

All standardized scoring procedures were followed. Age-based reliability coefficients for Sentence Composition range from .84–.88 for students ages 13–16 (Breaux, 2009). The stability coefficient for Sentence Composition is moderate, with a corrected r of .76 (Breaux, 2009).

To generate student writing samples at the paragraph/essay level, the Essay Composition subtest of the WIAT-III was administered. This subtest measures students' expository writing in response to the prompt, "Write about your favorite game. Include at least 3 reasons why you like it."

All standardized administration and scoring directions were followed for the total number of words written as well as Theme Development and Text Organization. Age-based reliability coefficients for Essay Composition range from .87–.88 for students ages 13–16 (Breaux, 2009). The stability coefficient for Essay Composition is strong, with a corrected *r* of .91 (Breaux, 2009).

Self-regulation. The *Behavior Rating Inventory of Executive Function – Self-Report (BRIEF-SR)* (Guy, Isquith, & Gioia, 2004a) is a standardized psychological student self-report instrument of 80 items that is designed to assess children's and adolescents' views of their EF and self-regulatory behaviors across typical, everyday environments (Guy, Isquith, & Gioia, 2004b). All items are negatively worded and use a 3-point scale response format (1 = never a problem, 2 = sometimes a problem, and 3 = often a problem). Items include statements such as, "I don't plan ahead for school assignments," "I have problems organizing my written work," and "I talk at the wrong time."

Cronbach alpha coefficients range from .72–.87 for the clinical scales and are slightly higher for the Behavioral Regulation Index (BRI; .93), Metacognitive Index (MI; .95), and Global Executive Composite (GEC; .96) (Guy et al., 2004b). Stability coefficients range from .59–.85 and .84–.89 for the clinical scales and indices, respectively, over a period of 1–10 weeks (Guy et al., 2004b). Validation information (e.g., content, convergence-discriminant, and criterion validity) is not sufficiently available for the BRIEF-SR. For the purposes of this study, only the GEC, BRI, and MI composite scores, and the WM and Planning/Organization clinical scales were fully calculated; raw scores were converted to *t* scores following the standardized scoring procedures.

Students also completed a five-minute planning measure similar to that of Vanderberg and Swanson (2007), as planning is a self-regulated writing technique that can impact the quality of one's writing (e.g., Spivey & King, 1989). To assess their observable planning, students were provided with a blank sheet of paper prior to completing the WIAT-III Essay Composition subtest and instructed, "If you'd like, you can use this blank page to plan what you will write." Students' planning was evaluated using a 5-point holistic, qualitative rubric used and explained previously in the literature (see Berninger, Whitaker, Feng, Swanson, & Abbott, 1996; Vanderberg & Swanson, 2007; Whitaker, Berninger, Johnston, & Swanson, 1994).

Memory measures. The five subtests composing the Working Memory Index (WMI) of the *Wechsler Intelligence Scale for Children – V* (WISC-V) (Wechsler, 2014a) were individually administered. The WISC-V is a standardized assessment that measures a student's intellectual or cognitive ability, and is appropriate for students aged 6–16 years. All measures of the WMI were administered (e.g., Digit Span [Forward, Backward, Sequencing] and Picture Span) in addition to Letter Number Sequencing (LNS; which is optional), and scored according to the standardized set of directions.

Average reliability coefficients across the Digit Span subtest for students ages 13–16 range from .79–.85 for the Forward task, .78–.82 for the Backward task, and .77–.85 for the Sequencing task. Overall average reliability coefficients are .81, .80, and .82 for Forward, Backward, and Sequencing, respectively, and stability coefficients (corrected *r*) are .82, .76, and .79 (Wechsler, 2014b). Average reliability coefficients across ages 13–16 on the Picture Span subtest range from .83–.85, with an overall reliability coefficient of .85, and a stability coefficient (corrected *r*) of .80 (Wechsler, 2014b). Average reliability coefficients across ages 13–16 for the LNS subtest range from .82–.89, with an overall reliability coefficient of .86 and a stability coefficient (corrected *r*) of .82 (Wechsler, 2014b).

Procedures

All assessments were administered by the first author and one trained instructional coach (a certified special education teacher) from the participating school district during students' scheduled English classes. Tasks were completed across 17 days within a 6-week period from November–December 2015. WISC-V measures were administered individually, while all other measures were administered in groups of 11–16 students. Throughout the study, data were collected on the time of administration per assessment and/or per assessment session for a small sample of students and classes. Total administration time using mean scores was 139 minutes. Administration of all measures – including subtests – was stratified across classes.

Reliability

Reliability with the instructional coach was set at 100% for administration of all measures. On the initial check-out session, the instructional coach secured 51 of a possible 55 points on the reliability form for 93% accuracy. Inaccuracies were reviewed immediately. Approximately one week later, the principal investigator presented the instructional coach with short retrials on the items missed. These were completed with accuracy and discussed.

Inter-scorer reliability across measures was set at a minimum of 90%. All individuals who assisted with scoring were trained by the principal investigator on the requisite procedures. Scorers assisting on scoring the WIAT-III Sentence Composition subtests, Essay Composition, and the DASH had not participated in any level of data collection.

Data Analysis

Structural equation modeling (SEM) and exploratory factor analysis (EFA) using IBM SPSS AMOS 22 were used to examine whether the hypothesized model fit the data (i.e., to confirm the null hypothesis that the measurement model of the SVW is correctly specified) and to identify the number of factors represented by the data. Model fit was evaluated using chi-square statistics (χ^2), the comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residuals (SRMR). In SEM, chi-square values should be nonsignificant, and Hu and Bentler (1998, 1999) have recommend that CFI and TLI be at least .95, with cutoff values of .06 for RMSEA and .08 for SRMR. One-way analysis of variance (ANOVA) was also run to determine whether statistically significant differences existed between struggling and non-struggling writers on the observed variables.

Results

Descriptive Statistics

As displayed in Table 1, students' mean performance on the standardized academic and cognitive measures, along with the self-regulation measure, were in the average to above-average range. Measures demonstrated low to acceptable reliability (Cronbach's αs = .56–.78).

Tables 2 and 3 show inter-correlation coefficients and covariances, with variances reflected on the diagonal in bold on Table 3. Transcription and text generation measures were somewhat weakly to strongly related ($.13 \leq rs \leq .86$). WM was similarly correlated with the transcription and text generation skills ($.07 \leq rs \leq .50$). Self-regulation EFs were weakly to moderately negatively correlated with WM ($-.34 \leq rs \leq -.09$) and weakly correlated with the transcription and text generation skills ($-.25 \leq rs \leq .06$). As with the inter-correlations, all covariances were positive with the exception of those with the BRIEF-SR. This was to be expected as items are negatively worded and were not reverse-coded.

Evaluating the Measurement Model

In order to verify that writing is composed of various factors, and that each variable uniquely contributes, SEM was used to evaluate the fit of the hypothesized measurement model (see Figure 1). As illustrated, the model exhibited poor model fit ($\chi^2(21) = 40.709$, $p = .006$, CFI = .855, TLI = .751, RMSEA = .117, SRMR = .0880), and the matrix was non-positive definite. According to Kline (2011), a non-positive definite matrix may occur when (a) the data do not provide enough information (e.g., small sample size, only two indicators per factor); (b) the model contains too many parameters; (c) the sample contains outliers or the data are not normally distributed; (d) there is underidentification of factor covariances; or (d) the measurement model is misspecified.

In an effort to account for the use of composite scores, two additional iterations of the model were evaluated using only the MI, before being evaluated using the WM and Planning/Organization scales

Table 1
Descriptive Statistics

Measure	All Students		Above 25th %tile		At or Below 25th %tile		
	(*N* = 69)		(*n* = 61)		(*n* = 8)		*F*
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Working Memory Index (WMI)	101.44	12.76	102.98	11.85	89.63**	14.10	8.61
Letter Number Sequencing[a]	9.71	2.47	10.18	2.18	6.13**	1.46	25.99
WIAT-III Spelling	104.83	13.96	107.89	11.55	81.50**	6.70	39.63
WIAT-III Sentence Composition	101.42	15.27	104.69	12.81	76.50**	7.39	36.79
Planning[b]	3.04	1.17	3.20	1.12	1.88**	0.83	10.28
WIAT-III Essay Composition	106.30	11.91	108.30	10.65	91.13**	10.41	18.48
WIAT-III EC WC	112.83	12.83	114.61	11.97	99.25**	11.59	11.72
WIAT-III EC TD	98.33	14.39	100.26	13.50	83.63**	13.06	10.82
BRIEF-SR GEC[c]	57.88	10.88	57.46	11.23	61.13	7.45	.80
BRIEF-SR BRI[c]	56.59	10.43	56.13	10.73	60.13	7.32	1.04
BRIEF-SR MI[c]	57.80	11.36	57.41	11.62	60.75	9.22	.61
BRIEF-SR WM[c]	58.96	12.25	59.02	12.62	58.50	9.53	.01
BRIEF-SR PO[c]	56.97	10.26	56.53	10.53	60.38	7.63	1.00
DASH	97.29	13.79	99.53	12.30	80.25**	13.22	17.08
Graphic Speed	9.77	4.16	10.07	4.21	7.50	3.07	2.76

Note.[a] = scaled score; [b] = raw score; [c] = *t* score; ** = $p \leq .01$; WIAT-III = Wechsler Individual Achievement Test – III; WIAT-III EC WC = Word Count score of the Wechsler Individual Achievement Test – III Essay Composition subtest; WIAT-III EC TD = Theme Development and Text Organization score of the Wechsler Individual Achievement Test – III Essay Composition subtest; BRIEF-SR GEC = Global Executive Composite of the Behavior Rating Inventory of Executive Function – Self-Report; BRIEF-SR BRI = Behavioral Regulation Index of the Behavior Rating Inventory of Executive Function – Self-Report; BRIEF-SR MI = Metacognition Index of the Behavior Rating Inventory of Executive Function – Self-Report; BRIEF-SR WM = Working Memory scale of the Behavior Rating Inventory of Executive Function – Self-Report; BRIEF-SR PO = Planning/Organization scale of the Behavior Rating Inventory of Executive Function – Self-Report; DASH = Detailed Assessment of Speed of Handwriting.

of the BRIEF-SR. Both models also revealed poor model fit ($\chi^2(21) = 43.818$, $p = .002$, CFI = .833, TLI = .713, RMSEA = .126, SRMR = .0891; and $\chi^2(38) = 104.365$, $p = .000$, CFI = .647, TLI = .488, RMSEA = .160, SRMR = .1221, respectively) with non-positive definite matrices.

Modification indices calculated throughout these iterations suggested adding a covariance between residual terms for variables on different factors. However, adding such residual covariances is an unacceptable modification, as adding residual covariances for these items tends to suggest that they are potentially measuring similar constructs. Thus, it was necessary to explore the factor structure.

Exploring the Factor Structure

Results of a factor analysis using the composite scores for Essay Composition and the BRIEF-SR (using maximum likelihood estimation with an oblique rotation in IBM SPSS) revealed a 2-factor model with good fit ($\chi^2 = 14.725$, $df = 19$, $p = .740$), explaining 54% of the variance; eigenvalues were above

Table 2
Inter-Correlation Coefficients

	LNS	WMI	Spell	SC	Plan	WC	TD	EC	BRIEF _WM	BRIEF _PO	BRIEF _BRI	BRIEF _MI	BRIEF _GEC	DASH	GS
LNS	1														
WMI	.50**	1													
Spell	.42**	.49**	1												
SC	.50**	.50**	.62**	1											
Plan	.24*	0.07	0.13	.26*	1										
WC	.38**	0.14	.27*	.29*	.39**	1									
TD	0.21	0.1	0.2	.25*	.25*	.41**	1								
EC	.35**	0.14	.28*	.33**	.37**	.82**	.86**	1							
BRIEF_WM	-0.09	-0.23	-0.08	-0.11	-0.02	0.00	-0.01	-0.01	1						
BRIEF_PO	-0.1	-0.14	-0.16	-0.21	0.02	-0.04	0.03	-0.01	.71**	1					
BRIEF_BRI	-0.23	-0.34**	-0.21	-.25*	0.00	-0.02	-0.06	-0.05	.61**	.67**	1				
BRIEF_MI	-0.14	-.27*	-0.18	-0.22	-0.01	-0.05	-0.01	-0.04	.91**	.89**	.69**	1			
BRIEF_GEC	-0.19	-.32**	-0.21	-.25*	-0.00	-0.03	-0.03	-0.04	.85**	.86**	.90**	.94**	1		
DASH	.37**	.33**	.35**	.36**	.40**	.58**	.37**	.57**	0.05	0.06	-0.03	-0.01	-0.02	1	
GS	.27*	0.22	0.17	0.18	.31*	0.12	0.03	0.09	0.05	-0.00	-0.04	-0.07	-0.06	.25*	1

Note. ** = $p \leq 0.01$, 2-tailed. * = $p \leq 0.05$, 2-tailed. LNS = Letter Number Sequencing subtest of the Wechsler Intelligence Scale for Children – V (WISC-V); WMI = Working Memory Index of the WISC-V; Spell = Spelling subtest of the Wechsler Individual Achievement Test – III (WIAT-III); SC = Sentence Composition subtests of the WIAT-III; Plan = Planning; WC = Word Count score for Essay Composition subtest of the WIAT-III; TD = Theme Development and Text Organization score of the Essay Composition subtest of the WIAT-III; EC = Essay Composition subtest of the WIAT-III; BRIEF_WM = Working Memory scale of the Behavior Rating Inventory of Executive Function – Self-Report (BRIEF-SR); BRIEF_PO = Planning/Organization scale of the BRIEF-SR; BRIEF_BRI = Behavioral Regulation Index of the BRIEF-SR; BRIEF_MI = Metacognition Index of the BRIEF-SR; BRIEF_GEC = Global Executive Composite of the BRIEF-SR; DASH = Detailed Assessment of Speed of Handwriting; GS = Graphic Speed subtest of the DASH.

1.0 when modeling using the BRIEF-SR GEC. The 2-factor model specified by the output consisted of one factor that included memory and more transcription-level variables (WMI, LNS, Spelling, Sentence Composition, and the BRIEF-SR GEC) and another factor that included text generation and writing fluency-level variables (Essay Composition, DASH, and Planning). The Graphic Speed subtest of the DASH did not appear to load on either factor (see Table 4). Factor loadings of .4 or higher were deemed appropriate for accepting an observed variable as a representation of the latent factor.

Two additional EFAs were also explored. When modeling using the BRIEF-SR MI, the factor analysis revealed a 3-factor model with good fit (χ^2 = 11.418, *df* = 12, *p* = .493), explaining 65% of the variance. When modeling using the WM and Planning/Organization scales of the BRIEF-SR and the Word Count and Theme Development and Text Organization scores from the Essay Composition subtest of the WIAT-III, a 4-factor model with good fit was obtained (χ^2 = 13.096, *df* = 17, *p* = .730), explaining 70% of the variance; eigenvalues were above 1.0 for each (see Table 4).

However, both models were discarded because one factor was primarily supported by one variable, adding nothing interesting to the model. Thus, the most parsimonious model, the 2-factor model (Transcription/Memory + Text Generation), was retained. Even after modeling with the uncom-

Table 3
Covariance-Variance Matrix

	LNS	WMI	Spell	SC	Plan	WC	TD	EC	BRIEF _GEC	DASH	GS	BRIEF _WM	BRIEF _PO	BRIEF _BRI	BRIEF _MI
LNS	**6.12**														
WMI	15.86	**162.93**													
Spell	14.54	87.77	**194.82**												
SC	18.80	97.76	131.77	**233.16**											
Plan	0.70	1.03	2.08	4.61	**1.37**										
WC	12.16	22.83	48.46	57.13	5.80	**164.71**									
TD	7.60	17.78	39.62	55.62	4.24	76.27	**207.14**								
EC	10.40	21.78	46.66	60.34	5.21	125.47	147.06	**141.86**							
BRIEF_GEC	-5.03	-44.32	-31.18	-40.83	-0.02	-4.24	-3.96	-4.73	**118.46**						
DASH	12.66	57.58	67.88	75.91	6.44	103.30	73.40	92.98	-2.78	**190.21**					
GS	2.74	11.85	9.75	11.41	1.50	6.30	1.51	4.26	-2.70	14.05	**17.33**				
BRIEF_WM	-2.68	-35.85	-13.82	-20.83	-0.22	0.15	-1.54	-1.13	112.72	8.35	2.71	**149.98**			
BRIEF_PO	-2.61	-18.43	-23.52	-32.72	0.19	-5.84	4.28	-1.07	96.16	8.42	-0.12	89.25	**105.35**		
BRIEF_BRI	-5.84	-44.62	-30.04	-39.08	0.00	-2.20	-9.26	-6.17	101.59	-3.93	-1.77	78.10	71.74	**108.69**	
BRIEF_MI	-3.85	-38.68	-28.82	-37.77	-0.15	-6.70	-1.70	-4.95	116.04	-1.57	-3.11	125.83	103.85	81.61	**129.02**

Note. Variances appear on the diagonal in bold. LNS = Letter Number Sequencing subtest of the Wechsler Intelligence Scale for Children – V (WISC-V); WMI = Working Memory Index of the WISC-V; Spell = Spelling subtest of the Wechsler Individual Achievement Test – III (WIAT-III); SC = Sentence Composition subtests of the WIAT-III; Plan = Planning; WC = Word Count score of the Essay Composition subtest on the WIAT-III; TD = Theme Development and Text Organization score of the Essay Composition subtest on the WIAT-III; EC = Essay Composition subtest of the WIAT-III; BRIEF_GEC = Global Executive Composite of the Behavior Rating Inventory of Executive Function – Self-Report (BRIEF-SR); DASH = Detailed Assessment of Speed of Handwriting; GS = Graphic Speed subtest of the DASH; BRIEF_WM = Working Memory scale of BRIEF-SR; BRIEF_PO = Planning/Organization scale of the BRIEF-SR; BRIEF_BRI = Behavioral Regulation Index of the BRIEF-SR; BRIEF_MI = Metacognition Index of the BRIEF-SR.

bined composite scores, similar variables continued to group consistently and load on similar factors.

Performance of Struggling Writers

Performance at or below the 25th percentile on the WIAT-III Writing Composite score was selected as the cutoff for students who struggle with writing, as performance below this cut-score is indicative of a student who performs below average in writing compared with a normative sample. Eight students (n = 8) within the sample met this criterion. The subsample of struggling writers performed in the low-average and below-average ranges across most of the standardized assessments. One-way ANOVAs revealed statistically significant differences between students who scored at or below the 25th percentile on the WIAT-III Writing Composite and students who scored above the 25th percentile on all measures except the BRIEF-SR and the Graphic Speed subtest of the DASH (refer to Table 1).

Discussion

The purpose of this exploratory study was to test the SVW model in order to explore the relations amongst transcription, text generation, self-regulation, and WM at ninth grade.

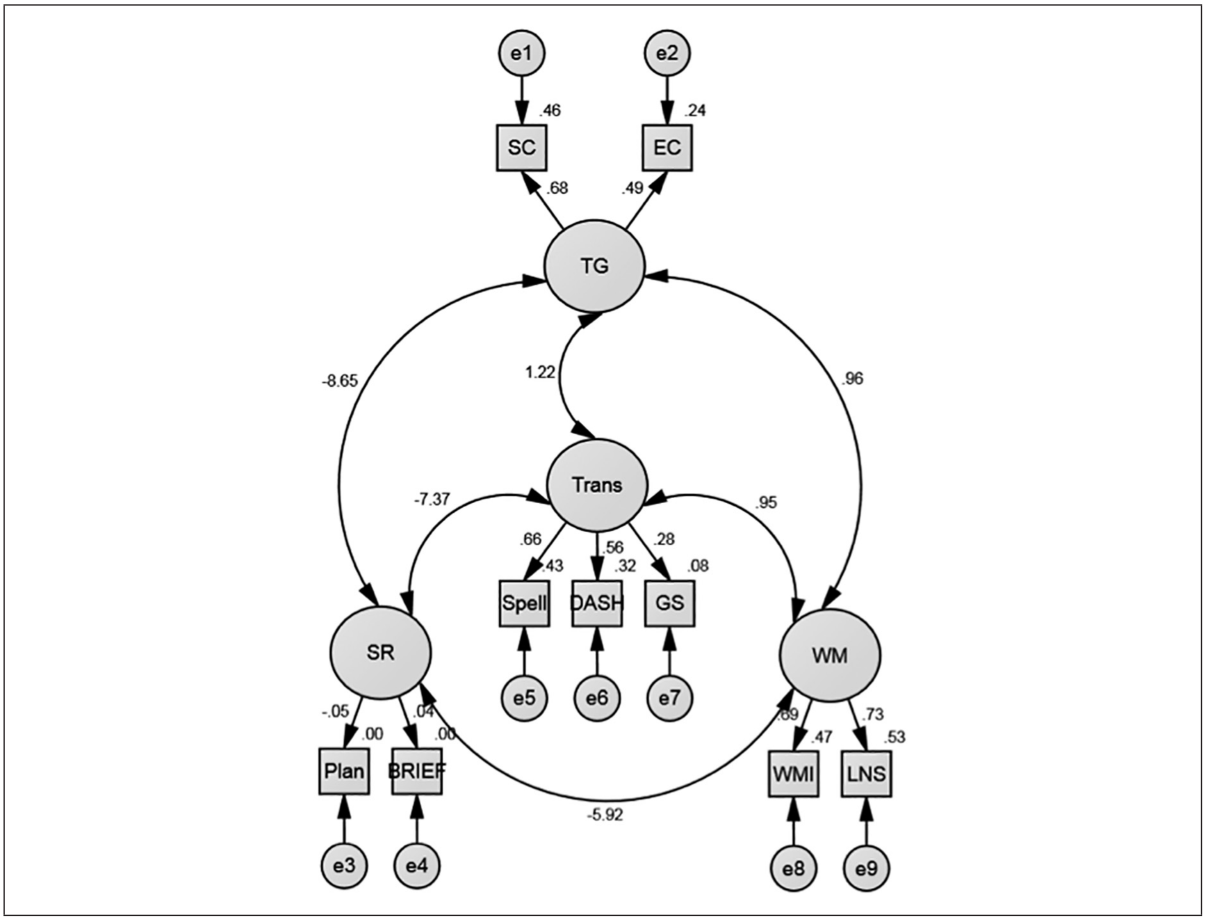

Figure 1. 4-Factor measurement model with standardized estimates – GEC.

Note. SC = Sentence Composition subtests of the Wechsler Individual Achievement Test – III (WIAT-III); EC = Essay Composition subtest of the WIAT-III; TG = Text Generation; Trans = Transcription; Spell = Spelling subtest of the WIAT-III; DASH = Detailed Assessment of Speed of Handwriting; GS = Graphic Speed subtest of the DASH; SR = Self-Regulatory Executive Functions; Plan = Planning; BRIEF = Behavior Rating Inventory of Executive Function – Self-Report Global Executive Composite; WM = Working Memory; WMI = Working Memory Index of the Wechsler Intelligence Scale for Children – V (WISC-V); LNS = Letter Number Sequencing subtest of the WISC-V.

Relative Associations of the Components of Writing: The Present Study

In line with previous research (e.g., Berninger et al., 2002; Kim, Al Otaiba, Sidler, Greulich, & Paranik, 2014; Kim et al., 2015; Puranik, Lombardino, & Altman, 2008; Wagner et al., 2011), this study confirms that writing is multidimensional rather than a single construct. However, unlike the previous research that has identified factors specific to singular constructs of the SVW (e.g., transcription and text generation) (e.g., Graham et al., 1997) or factors identified with oral language abilities and reading (see Abbott & Berninger, 1993; Abbott et al., 2010), the findings of the present study suggest that factors of writing at the high school level are multidimensional and do not appear as singular constructs that can be individually evaluated. In further examining the factors from this study (Transcription/WM + Text Generation), a few interesting findings emerge.

First, the composition of the factors identified in this study point to the complex and embedded cognitive structures of writing (Berninger & Amtmann, 2003; Berninger & Winn, 2006; McCutchen, 1996). Indeed, the first factor is representative of both transcription and memory. Theoretically, this association is plausible, given that Swanson and Berninger (1996) noted that transcription skills are more closely related to STM, and text generation skills are more closely related to WM. While the current study used measures that purportedly assess WM, it could be argued that these tasks are not pure representations of WM as students were not expected to hold anything in mind while manipulating extraneous information. Moreover, Berninger et al. (2002), Berninger and Amtmann (2003), and Berninger and Winn (2006) suggested that WM within the model of the SVW must simultaneously tap both LTM and STM, depending on the task being completed.

Second, the Graphic Speed subtest of the DASH did not load strongly on either factor of the accepted model. Though this subtest did not provide an impact in the present study, Berninger and colleagues (e.g., Berninger & Amtmann, 2003; Berninger et al., 2002; Berninger & Winn, 2006) suggested that visual-spatial abilities are important to writing, and Baddeley and Hitch (1974) included a visual-spatial sketchpad within their dual processing model of WM. The lack of an association of visual-spatial abilities as captured through the Graphic Speed task in the current study warrants further investigation.

Third, the Sentence Composition measure was more strongly related to transcription- and memory-level skills than to text generation skills. According to the SVW, transcription-level skills are typically thought of as letter- and word-level abilities, whereas text generation is more representative of connected text, in which students are expected to string words together to form thoughts at a sentence level or higher. However, it may be that for high school students, the ability to generate and combine sentences is a basic or lower-level writing skill that is essential for generating connected text. It is possible that efficiency with sentence writing skills for high school students enables them to expend more cognitive resources on crafting more involved text (Kim et al., 2015).

Fourth, the Essay Composition measure from the WIAT-III was more strongly related to text generation. Kim et al. (2015) reported that the theme and organization score of the Essay Composition subtest of the WIAT-III was predictive of a writing quality factor rather than a writing productivity factor in their sample of second- and third-grade students. Thus, it may be that as students grow older, the functions or dimensions of the measure change, given that older students are more likely to generate longer text. Even when the Essay Composition subtest was broken into its component parts – Word Count and Theme Development and Text Organization – the EFAs revealed similar factor structures.

Fifth, the correlation between the WMI and the BRIEF-SR GEC was small to moderate and negatively statistically significant ($r = -.32$; $p \leq .01$). This tends to suggest a negative relationship between these items, in which an increase in WM would result in a decrease of negative or ineffective EFs. As Kane, Bleckley, Conway, and Engle (2001) and Kane et al. (2007) have suggested, along with Cowan (2014), differences in WM may reflect the ability to maintain attention and focus throughout an activity. It is possible that the same is true for writing.

Finally, the two self-regulatory EF measures loaded on different factors within this study, even when compound variables were broken apart (e.g., breaking apart Word Count and Theme Development and Text Organization scores from the Essay Composition subtest of the WIAT-III into separable scores, or modeling with just a single index from the BRIEF-SR). Berninger and Winn (2006) outlined EFs of the SVW model to include: supervisory attention (inhibition, selection of relevant information, attentional shifting, attention [staying on task], cognitive engagement and presence, and metalinguistic and metacognitive awareness), goal setting, planning, reviewing, revising, and strategies for self-regulating and monitoring. The BRIEF-SR GEC captures many of these same domains within its eight subscales (e.g., inhibit, shift, emotional control, monitor, WM, plan/organize, organization of materials, and task completion) (Guy et al., 2004b). Interestingly, the WM measures from the WISC-V similarly account for many of these EFs. For example, moving between Digit Span tasks requires cognitive flexibility or shifting, along with WM and focused attention (Wechsler, 2014b). Picture Span requires WM and response inhibition, and LNS requires focused attention and WM (Wechsler, 2014b). Thus, it seems reasonable that the BRIEF-SR GEC would load on a factor with both the WMI and LNS.

However, the provision of a brief planning period loaded on the second factor, which was more closely aligned with text generation and writing fluency. Though this might be expected, especially because the planning period was specific to the response prepared for the WIAT-III Essay Composition task, it is possible that specific planning

Table 4
Factor Loadings Across EFA Models

Model	Variable	Pattern Matrix Factor 1	Pattern Matrix Factor 2	Structure Matrix Factor 1	Structure Matrix Factor 2	Model	Pattern Matrix Factor 1	Pattern Matrix Factor 2	Pattern Matrix Factor 3	Structure Matrix Factor 1	Structure Matrix Factor 2	Structure Matrix Factor 3
Composite scores for EC and the BRIEF-SR	WMI	.730		.731	.264	Model with BRIEF-SR MI		0.771	-0.112		0.727	0.2
	SC	.667	.204	.741	.445			0.699	0.143		0.755	0.405
	Spelling	.660	.138	.710	.376			0.701			0.728	0.333
	LNS	.517	.275	.616	.461			0.558	0.193	0.113	0.634	0.427
	BRIEF GEC / MI	-.421	.143	-.370			0.243	-0.106		0.252		
	EC		.732	.252	.728		-0.136		0.839		0.319	0.805
	DASH	.110	.715	.368	.755			0.208	0.609	0.169	0.447	0.698
	Planning		.568	.150	.548		0.186		0.481	0.295	0.2	0.527
	GS	.173	.211	.249	.273		0.975	0.297		0.961	0.275	0.262

Model	Variable	Pattern Matrix Factor 1	Pattern Matrix Factor 2	Pattern Matrix Factor 3	Pattern Matrix Factor 4	Structure Matrix Factor 1	Structure Matrix Factor 2	Structure Matrix Factor 3	Structure Matrix Factor 4
Model with Component Variables	BRIEF_WM	1.014				0.997	-0.153		
	BRIEF_PO	0.697				0.718	-0.215		
	Spelling			0.784		-0.1	-0.128	0.762	0.328
	SC		0.759			-0.157	0.783	0.379	0.216
	WMI	-0.132	0.651	-0.113	0.175	-0.266	0.685	0.196	0.331
	LNS		0.49	0.185	0.178	-0.117	0.621	0.431	0.373
	Word Count			0.843			0.323	0.828	0.184
	DASH		0.172	0.593	0.161		0.444	0.707	0.379
	Theme Develop.			0.517	-0.102	0.241	0.514		
	Planning			0.442	0.335		0.203	0.502	0.433
	GS		0.102		0.59		0.253	0.181	0.615

Note. BRIEF GEC / MI = Global Executive Composite (2-factor EFA) or the Metacognition Index (3-factor EFA) of the Behavior Rating Inventory of Executive Function – Self-Report (BRIEF-SR); BRIEF_WM = Working Memory scale of the BRIEF-SR; BRIEF_PO = Planning/Organization scale of the BRIEF-SR; Spelling = Spelling subtest of the Wechsler Individual Achievement Test – III (WIAT-III); SC = Sentence Composition subtests of the WIAT-III; WMI = Working Memory Index of the Wechsler Intelligence Scale for Children – V (WISC-V); LNS = Letter Number Sequencing subtest of the WISC-V; Word Count = Word Count score of the Essay Composition subtest of the WIAT-III; DASH = Detailed Assessment of Speed of Handwriting; Theme Develop. = Theme Development and Text Organization of the Essay Composition subtest of the WIAT-III; Planning = Planning Measure; GS = Graphic Speed subtest of the DASH.

abilities aid in the generation of text on a central topic and support fluency with written expression. Indeed, researchers who have provided planning time for middle and high school students have often found positive gains in student text (Spivey & King, 1989; Vanderberg & Swanson, 2007).

Alternatively, it is possible that this text generation (fluency) factor represents higher-order writing and cognitive skills, as it is specific to being able to craft connected text with fluency. Swanson and Berninger (1996) noted that WM is related to higher-order writing skills, which they identified as planning, organizing, and text generation. Considering this factor as the higher-order factor would also be consistent with the early model of the SVW, in which the higher-order variable was ideation, even though Berninger and colleagues (e.g., Berninger & Swanson, 1994; Berninger et al., 1991; Berninger et al., 1992) viewed idea generation as a component of text generation, or transforming ideas into language representations.

The present study seems to corroborate Berninger and colleagues' interpretation, that generating ideas – and subsequently planning – is specific to text generation.

Struggling Writers

Descriptive results for a small group of struggling ninth-grade writers (*n* = 8) (based on performance at or below the 25th percentile on the WIAT-III Writing Composite Score) revealed statistically significant differences on most measures, though differences on the WIAT-III measures would have been expected. These students were not different from their peers on the Graphic Speed subtest, which measures visual-spatial abilities, or in reporting difficulties with self-regulatory executive functions (as measured by the BRIEF-SR).

Ironically, the existing literature purports that struggling writers and writers with disabilities typically struggle with self-regulatory EFs (e.g., Benton, Kraft, Glover, & Plake, 1984; Effeney et al., 2013; Graham & Harris, 2012). It may be that struggling writers can provide a similarly accurate representation of their self-regulatory executive functions, but that they do not effectively utilize such skills. Moreover, different results may occur with a larger population of writers identified with specific learning disabilities in writing. This finding warrants further investigation.

Limitations

Several limitations apply to this study and may be classified into three primary categories: (a) sample size/composition and effects of sample size/composition, (b) measurement, and (c) reliability. First, the sample size used for this study (*N* = 69) was small for using statistical techniques like SEM and EFA. This was further complicated by the small number of students who received special education services (*n* = 2 or 2.9%) and the subsample of struggling writers (*n* = 8 or 12%). Further, all the students were from the same classroom; while this arrangement controls for teacher effects, the effects that may be produced by other teachers is unknown. Nonetheless, the sample was diverse racially, ethnically, and in terms of socio-economic status. However, such diversity cannot represent all high school students nationally, nor high school students across this midwestern district. Thus, it is possible that with a larger sample, more factors might be identified or that the factor structure would be differently arranged.

The next category of limitations is specific to measurement. Composite scores were utilized for select measures as this is consistent with the scoring and interpretation of the standardized assessments administered. However, use of these composite scores may skew the identification of a unitary construct (i.e., factor) and may also have contributed to the non-positive definite matrix observed in the hypothesized measurement model, though breaking apart these variables did not lead to a measurement model with a positive definite matrix. Moreover, a limited number of standardized assessments are available for evaluating self-regulatory EFs as they relate specifically to adolescent writing. The BRIEF-SR was selected because it is a standardized assessment; however, it does not solely measure self-regulation of writing.

Additionally, the present study only relied on expository writing tasks. It is possible that the inclusion of other genres of writing, especially narrative writing, would load differently across the factors, or change the cognitive constraints of writing. As McCutchen (1996) has noted, students' transcription processes with narrative text – a familiar text structure – are likely to be fluent by junior high.

Moreover, it is possible that the inclusion of a planning period in advance of the Essay subtest of the WIAT-III invalidated the standardized administration and scoring of the writing prompt. Although Vanderberg and Swanson (2007) used a similar planning period in advance of both a different standardized writing assessment and a researcher-developed writing probe, this must be considered for any possible impact it might have had on the quantity and quality of student writing that was produced.

The final area of limitations surrounds reliability. Early during data collection, a transposition error in the first trial of item 8 on the LNS subtest was identified. It was decided to re-administer the item to the impacted 18 students. Though it is possible that this error jeopardized the reliability of the data for the impacted students, students' scores essentially remained the same.

Implications for Practice

One educational implication from our findings is that intervention and instructional supports for high school students similar to those who participated in this study might address transcription-level writing skills, given that they loaded with memory and self-regulatory variables on the same factor. Some transcription-level supports are available for younger writers (e.g., Datchuk, Kubina, & Mason, 2015; Graham & Harris, n.d.), and while the extent to which these same supports will be effective with older learners is unclear, it is possible that similar supports will scaffold writing while lessening the constraints of memory and EFs. Specifically, supporting adolescents in crafting and combining sentences may be particularly useful, as struggling writers in this sample mainly lagged in this area when examining mean scores across the measures. Saddler (2012) suggested that writing good sentences is difficult, yet essential to the production of longer text as sentences are "vehicles of communication" (p. 6). Indeed, a lack of knowledge of effective sentence structures and sentence combining techniques can impede idea translation and text generation, draining cognitive resources.

Implications for Future Research

Overall, much work remains to be done to expand researchers' and teachers' understandings about the writing skills that influence writing development throughout high school (Graham, 2006; Kim et al., 2015). This includes research that replicates the present study. While researchers typically prefer working with parsimonious models, the most powerful way to theoretically ensure that researchers are truly capturing the most comprehensive view of writing is by working with complex models. This can be accomplished by incorporating additional parameters and measures in an effort to identify a model that is not only more representative of the data, but also enhances construct, convergent, and discriminant validity (Trochim, 2006). However, because adding additional measures to the assessment battery can be costly; require numerous resources, including personnel; and place demands on research participants, including a significant loss of instructional time (which are substantive grounds for districts and for parents/guardians to deny participation/consent), researchers might consider alternative sources of data for modeling purposes (e.g., historical data or data available from large national data sets).

Research with elementary-aged writers has explored the role of alternative variables in relationship to writing. For example, Abbott and Berninger (1993) explored oral language measures, whereas Abbott et al. (2010) modeled reading and writing variables. Modeling both oral language and reading variables with secondary students is also warranted.

Another area of particular interest for adolescents is the role of personal self-efficacy beliefs and motivation for writing. Many adolescents, especially struggling writers, have experienced years of failure in writing, with feedback often emphasizing what students have done incorrectly, rather than offering a means by which to improve their writing. It is possible that such variables account for additional variance.

The population from which students are sampled is also a viable direction for future research. As this study only considered students in one teacher's English classes, future research might consider modeling with refined student populations, such as a sample of equal numbers of students identified as learners with specific learning disabilities in written expression and their non-disabled peers, or even a sample of high school students across grades 9–12. With similarly sized sub-groups of students, multi-group analysis can be conducted to explore whether the structural paths of an identified and good fitting model are invariant or not across the groups. Use of longitudinal SEM would also provide rich data about student writing over time.

As researchers continue to model the dimensionality of writing, they must carefully consider the extent to which such models fully represent writing and how the models can be used to name and understand the challenges that adolescents encounter in writing. Only then, can suggestions for intervention and instruction be made (Graham, 2006).

This study suggests possible relationships and is a snapshot of writing from a single writing genre. However, given the complexity of writing, researchers may need to continue to explore more multi-component intervention and instructional materials to support adolescents' often intractable and entrenched writing needs. Indeed, recent research in modeling continues to posit that writing is multidimensional (e.g., Kim et al., 2014, 2015; Puranik et al., 2008; Wagner et al., 2011).

Conclusion

Modeling of writing has provided, and will continue to provide, a way for understanding the complexity and interconnected nature of writing. This exploratory study provides preliminary insight on the "pieces" of adolescent writing as they relate to the SVW. Though the results suggest a possible multidimensionality of the component skills, continued work in this area offers promise for better understanding adolescents' struggles in writing and later designing effective intervention and instructional writing routines.

References

Abbott, R. D., & Berninger, V. W. (1993). Structural equation modeling of relationships among developmental skills and writing skills in primary- and intermediate-grade writers. *Journal of Educational Psychology, 85*(3), 478–508. doi:10.1037/0022-0663.85.3.478

Abbott, R. D., Berninger, V. W., & Fayol, M. (2010). Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *Journal of Educational Psychology, 102*(2), 281–298. doi:10.1037/a0019318

Baddeley, A. D., & Hitch, G. J. (1974). Working memory. In G. A. Bower (Ed.), *The psychology of learning and motivation* (pp. 47–89). New York, NY: Academic Press.

Barnett, A., Henderson, S. E., Scheib, B., & Schulz, J. (2007a). *Detailed Assessment of Speed of Handwriting (DASH).* London, UK: Pearson.

Barnett, A., Henderson, S. E., Scheib, B., & Schulz, J. (2007b). *Detailed Assessment of Speed of Handwriting (DASH) manual*. London, UK: Pearson.

Benton, S. L., Kraft, R. G., Glover, J. A., & Plake, B. S. (1984). Cognitive capacity differences among writers. *Journal of Educational Psychology, 76*(5), 820–834. doi:10.1037/0022-0663.76.5.820

Berninger, V. W. (1999). Coordinating transcription and text generation in working memory during composing: Automatic and constructive processes. *Learning Disability Quarterly, 22*, 99–112. doi:10.2307/1511269

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 345–363). New York, NY: Guilford Press.

Berninger, V. W., & Graham, S. (1998). Language by hand: A synthesis of a decade of research on handwriting. *Handwriting Review, 12*, 11–25.

Berninger, V. W., Mizokawa, D. T., & Bragg, R. (1991). Theory-based diagnosis and remediation of writing disabilities. *Journal of School Psychology, 29*, 57–79. https://doi.org/10.1016/0022-4405(91)90016-K

Berninger, V. W., & Richards, T. L. (2002). *Brain literacy for educators and psychologists*. New York, NY: Academic Press.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writing. In E. C. Butterfield (Ed.), *Advances in cognition and educational practice (Children's writing: Toward a process theory of the development of skilled writing)* (Vol. 2, pp. 57–81). Greenwich, CT: JAI Press Inc.

Berninger, V. W., Vaughan, K., Abbott, R. D., Begay, K., Coleman, K. B., Curtin, G., Hawkins, J. M., & Graham, S. (2002). Teaching spelling and composition alone and together: Implications for the Simple View of Writing. *Journal of Educational Psychology, 94*(2), 291–304. doi:10.1037/0022-0663.94.2.291

Berninger, V., Whitaker, D., Feng, Y., Swanson, H. L., & Abbott, R. D. (1996). Assessment of planning, translating, and revising in junior high writers. *Journal of School Psychology*, *34*(1), 23–52. doi:https://doi.org/10.1016/0022-4405(95)00024-0

Berninger, V., Whitaker, D., & Swanson, L. (1992). *Developmental and individual differences in planning, translating, and revising*. Riverside, CA: International Association of Cognitive Education.

Berninger, V. W., & Winn, W. D. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96–114). New York, NY: The Guilford Press.

Breaux, K. C. (2009). *WIAT-III Technical Manual*. San Antonio, TX: Pearson.

Cowan, N. (2014). Working memory underpins cognitive development, learning, and education. *Educational Psychology Review, 26*, 197–223. doi:10.1007/s10648-013-9246-y

Datchuk, S. M., Kubina, R. M., & Mason, L. H. (2015). Effects of sentence instruction and frequency building to a performance criterion on elementary-aged students with behavioral concerns and EBD. *Exceptionality, 23*, 34–53. doi:10.1080/09362835.2014.986604

Dockrell, J. E., Lindsay, G., & Connelly, V. (2009). The impact of specific language impairment on adolescents' written text. *Exceptional Children, 75*(4), 427–446. https://doi.org/10.1177/001440290907500403

Effeney, G., Carroll, A., & Bahr, N. (2013). Self-regulated learning: Key strategies and their sources in a sample of adolescent males. *Australian Journal of Educational & Developmental Psychology, 13*, 58–74.

Gough, P. B., & Tunmer, W. E. (1986). Decoding, reading, and reading disability. *Remedial and Special Education, 7*(1), 6-10. https://doi.org/10.1177/074193258600700104

Graham, S. (2006). Writing. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology* (2nd ed., pp. 457–478). Mahwah, NJ: Lawrence Erlbaum Associates.

Graham, S., Berninger, V. W., Abbott, R. D., Abbott, S. P., & Whitaker, D. (1997). Role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology, 89*(1), 170–182. doi:10.1037/0022-0663.89.1.170

Graham, S., Berninger, V., Weintraub, N., & Schafer, W. (1998). Development of handwriting speed and legibility in grades 1-9. *The Journal of Educational Research, 92*(1), 42–52. https://doi.org/10.1080/00220679809597574

Graham, S., & Harris, K. R. (n.d.). *CASL handwriting program (grade 1)*. Retrieved from http://peabody.vanderbilt.edu/docs/pdf/sped/CASL%20Handwriting%20Program.pdf

Graham, S., & Harris, K. R. (2012). *Writing better: Effective strategies for teaching students learning difficulties.* Baltimore, MD: Paul H. Brookes Publishing.

Guy, S. C., Isquith, P. K., & Gioia, G. A. (2004a). *Behavior Rating Inventory of Executive Function – Self-Report Version*. Lutz, FL: PAR.

Guy, S. C., Isquith, P. K., & Gioia, G. A. (2004b). *Behavior Rating Inventory of Executive Function – Self-Report Version: Professional manual*. Lutz, FL: PAR.

Harris, K. R., & Graham, S. (1999). Programmatic intervention research: Illustrations from the evolution of self-regulated strategy development. *Learning Disability Quarterly, 22*(4), 251-262. https://doi.org/10.2307/1511259

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1–27). Mahwah, NJ: Lawrence Erlbaum Associates.

Hayes, J. R., & Flower, L. S. (1980). Identify the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3–30). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to under-parameterized model misspecification. *Psychological Methods, 3*(4), 424–453. doi:10.1037/1082-989X.3.4.424

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55. doi:10.1080/10705519909540118

Juel, C., Griffith, P. L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78*(4), 243–255. doi:10.1037/0022-0663.78.4.243

Kane, M. J., Bleckley, M. K., Conway, A. R. A., & Engle, R. W. (2001). A controlled-attention view of working-memory capacity. *Journal of Experimental Psychology: General, 130*(2), 169–183. doi:10.1037/0096-3445.130.2.169

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience sampling study of working memory and executive control in daily life. *Psychological Science*, *18*(7), 614–621. doi:10.1111/j.1467-9280.2007.01948.x

Kline, R. B. (2011). *Principles and practice of structural equation modeling*. New York, NY: The Guilford Press.

Kim, Y-S., Al Otaiba, S., Sidler, J. F., Greulich, L., & Puranik, C. (2014). Evaluating the dimensionality of first-grade written composition. *Journal of Speech, Language, and Hearing Research, 57*, 199–211. doi:10.1044/1092-4388(2013/12-0152)

Kim, Y-S., Al Otaiba, S., Wanzek, J., & Gatlin, B. (2015). Toward an understanding of dimensions, predictors, and the gender gap in written composition. *Journal of Educational Psychology, 107*(1), 79–95. doi:10.1037/a0037210

Kim, Y-S., & Schatschneider, C. (2017). Expanding the developmental models of writing: A direct and indirect effects model of developmental writing (DIEW). *Journal of Educational Psychology, 109*(1), 35–50. doi:10.1037/edu0000129

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychologist, 8*(3), 299–325. doi:10.1007/BF01464076

McCutchen, D. (2011). From novice to expert: Implications of language skills and writing-relevant knowledge for memory during the development of writing skill. *Journal of Writing Research, 3*(1), 51–68. https://doi.org/10.17239/jowr-2011.03.01.3

Petrić, B., & Czárl, B. (2003). Validating a writing strategy questionnaire. *System, 31*, 187–215.

Puranik, C. S., Lombardino, L., & Altmann, L. (2008). Assessing the microstructure of written language using a retelling paradigm. *American Journal of Speech Language Pathology, 17*, 107–120. doi:10.1044/1058-0360(2008/012)

Saddler, B. (2012). *Teacher's guide to effective sentence writing*. New York, NY: The Guilford Press.

Section 504 of the Rehabilitation Act of 1973, 34 C.F.R. Part 104 (1973).

Spivey, N. N., & King, J. R. (1989). Readers as writers composing from sources. *Reading Research Quarterly, 24*(1), 7–26. https://doi.org/10.1598/RRQ.24.1.1

Swanson, H. L., & Berninger, V. W. (1996). Individual differences in children's working memory and writing skill. *Journal of Experimental Child Psychology, 63*, 358–385. doi:10.1006/jecp.1996.0054

Trochim, W. M. K. (2006). Measurement validity types. In *Research methods: Knowledge base* [Online]. Retrieved from http://www.socialresearchmethods.net/kb/measval.php

Vanderberg, R., & Swanson, H. L. (2007). Which components of working memory are important in the writing process? *Reading and Writing, 20*(7), 721–752. doi:10.1007/s11145-006-9046-6

Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing, 24*, 203–220. doi:10.1007/s11145-010-9266-7

Wechsler, D. (2009). *Wechsler Individual Achievement Test – Third Edition (WISC-III).* San Antonio, TX: Psychological Corporation.

Wechsler, D. (2014a). *Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V).* San Antonio, TX: Psychological Corporation.

Wechsler, D. (2014b). *Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V): Technical and interpretive manual*. Bloomington, MN: Psychological Corporation.

Whitaker, D., Berninger, V., Johnston, J., & Swanson, H. L. (1994). Intraindividual differences in levels of language in intermediate grade writers: Implications for the translating process. *Learning and Individual Differences, 6*(1), 107–130. doi:10.1016/1041-6080(94)90016-7