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The Component Reading and Writing Skills of At-Risk Undergraduates With Writing Difficulties

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Cognitive, word-level reading, spelling and writing measures were administered to academically at-risk undergraduates with writing difficulties to examine their literacy profiles; and performance was compared to typically-achieving writers. The at-risk students were slower and less accurate on measures of sight word reading, lexical decision, alpha-RAN, and were less accurate in making rhyming decisions for words that varied in their visual and phonological similarity than typically-achieving writers. Students also produced misspellings that were less orthographically plausible, and made more spelling errors and used less sophisticated vocabulary in their essays, despite good oral vocabulary, than students without writing difficulties. Findings are discussed in relation to the importance of well-developed word-specific knowledge into adulthood for skilled writing, and in relation to the effectiveness of self-report in the present study as a screening tool to research adult writing difficulties.

KEYWORDS: Writing Difficulties; Undergraduates; Reading Learning Disabilities; Self-Report

Postsecondary students with a history of learning disabilities (LD) view writing as an area of primary academic concern (Hatcher, Snowling, & Griffiths, 2002). Assessment methods draw heavily on students' writing skills, and writing difficulties persist in students with a history of LD, even when reading is compensated (e.g. Connelly, Campbell, MacLean, & Barnes, 2006; Lefly & Pennington, 1991). For many students, a high level of effort is exerted in order to maintain academic performance on par with their typically achieving peers (e.g., Corrigan, 1997), and a large proportion of students do not complete their degrees (Richardson & Wydell, 2003).

Composing written texts is arguably the most cognitively taxing of language production tasks requiring the integration of multiple processing demands across lower order (e.g., handwriting and spelling) and higher order (e.g., ideas generation and organization) skills (Bourdin, & Fayol, 1994; McCutchen, 2000). The revised simple view of writing model proposed by Berninger and Amtmann (2003) represents a dynamic functional writing system that involves the writer's activation of prior knowledge from long-term memory, word-specific knowledge (orthographic, phonological, and morphological storage units), metalinguistic and metacognitive awareness, and working memory that is represented as part of a distributed network of executive functions regulating focused attention to the writing task. Transcription (i.e., spelling and handwriting) is viewed within this system as a lower-order skill that with practice becomes automatized, thereby freeing up valuable cognitive resources for higher-order translation skills involved in planning, ideas generation, and organization in text production (Berninger & Amtmann, 2003). In an updated model on the cognitive aspects involved in the process of writing, Hayes (1996) has incorporated

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working memory as a critical mechanism overseeing the recursive steps in the writing process. This simple view of writing model provides a conceptual framework from which to examine individual differences in writing performance.

In a recent study conducted with postsecondary students with dyslexia in the UK, Connelly, Campbell, et al. (2006) found that lexical diversity, handwriting fluency, and working memory accounted for a large proportion of the variance in essay quality for the students with LD. Consistent with the simple view of writing model, Connelly, Campbell, et al. (2006) accounted for their findings based on the constraint that a lack of automaticity at the basic transcription level has to skilled writing in adults. Spelling, as one lower-order transcription skill, competes for necessary cognitive resources resulting in less text produced, more spelling errors, and reduced lexical diversity (Gregg, Hoy, & Sabol, 1988; Sterling, Farmer, Riddick Morgan, & Matthews, 1997; Wengelin, 2005) in written texts. Spelling problems may be due to (1) the residual effects of phonological processing problems that persist into adulthood (e.g., Bruck, 1992; Wilson & Lesaux, 2001) and (2) the fact that spelling in comparison to reading is less likely to be compensated in adults (e.g. Bruck, 1992 Lefly & Pennington, 1991; Snowling, 2000).

Individual differences in writing fluency (i.e., number of words written per minute) is considered the most important predictor of writing quality in university students (Wengelin, 2005) and effectively differentiates adults with writing difficulties from their typically-achieving peers (Peverly, 2006). Writing fluency problems have been found to have a particularly deleterious effect on exam performance as opposed to performance on in-class essays in students with LD (e.g., Connelly, Dockrell, & Barnett, 2005). Problems with writing fluency ostensibly constrain the efficiency with which lower-order and higher-order skills are coordinated within the functional writing system.

Research on the cognitive and literacy profiles of adults with a history of learning difficulties and current writing problems is needed to inform theory on the cognitive basis for written language difficulties in adults; this in turn has implications to postsecondary assessment and accommodation practices. Such research can provide the evidence necessary to mobilize appropriate services and support, increasing the likelihood that students successfully complete their programs. Examining the cognitive basis for writing difficulties in adults also provides insight into the specific areas that may be targeted early on in literacy development in an effort to prevent or reduce the negative impact of writing difficulties on academic outcomes into adulthood. The purpose of the present study was to examine the component reading and writing skills of students academically at risk because of their self-reported writing difficulties. Word-level reading, spelling, writing fluency, and essay writing performance were examined in addition to expressive vocabulary, phonological processing, alpha-numeric RAN, and working memory in order to investigate (a) the nature of students' writing difficulties from the perspective of the simple view of writing across lower-order and higher order aspects and (b) whether deficits in word-level reading would also be observed.

Method

Participants

At-risk students with writing difficulties. A total of 30 students with a self-reported history of learning difficulties and current writing problems impacting the quality of their written assignments and exams volunteered to participate after hearing about the project (1) through the university's writing centre, a venue that provides tutors (mainly English majors) to help students improve the quality of their writing, and (2) through the university's resource centre for students with disabilities. Of these students, 20 (11 woman, 9 men; mean age = 24.3 years, *SD* = 3.68) were confirmed to have writing difficulties based on achieving a standard score below the 25th percentile on the Written Expression subtest of the Wechsler Individual Achievement Test, 2nd (WIAT-II) Edition (The Psychological Corporation, 2002). Many of the students with writing difficulties (60%) reported that they had received special education services throughout elementary and secondary school; however, only 20% had received a formal diagnosis of a learning disability prior to beginning undergraduate study.

Typically-achieving writers. A total of 22 students without a history of learning difficulties or current writing problems (12 women, 10 men; mean age = 28.5 years, *SD* = 5.11) volunteered in response to a poster advertising an "adult writing study" for students with no history of writing difficulties or current writing problems. To be considered typically-achieving, students had to obtain a standard score at the 35th percentile or higher on the WIAT-II Written Expression subtest. An analysis of covariance (ANCOVA), adjusting for age, indicated that there was a significant effect for group on the WIAT-II Written Expression subtest, $F(1, 41) = 325.66$, $p < .0005$, $\eta^2 = .89$, with the adjusted mean performance of the group with writing difficulties ($M = 80.42$) significantly lower than the adjusted mean of the group without writing difficulties ($M = 102.29$).

Across both groups, most students (95%) were in their 2nd or 3rd year of a 4-year undergraduate program at a moderate-sized Canadian university. Based on an orally administered background questionnaire, all students were reported to be in good health, had no visual or auditory impairments, spoke English as a first language, had never sustained any head injury and were right-handed. Detailed verbal feedback on writing performance was provided to all participants by the graduate research assistants training in educational psychology and special education and supervised by the author.

Word-Level Reading Measures

A collection of word-level reading measures were administered that varied in the degree to which they assessed phonological and orthographic processing. As Greenberg, Ehri, and Perin (2002) noted in their study on the reading and spelling strategies of adult literacy students, the tasks were included in order to capture possible individual differences in the processing of phonological and orthographic aspects of words along a continuum.

Word recognition. The Letter-Word Identification subtest of the Woodcock-Johnson Tests of Achievement-Third Edition, WJ-III; (Woodcock, McGrew, & Mather, 2001) was administered based on standardized procedures to assess students' word-level reading skills. Testing was discontinued when students made six consecu-

tive errors. Standard scores (M = 100, SD = 15) were coded for each student. High internal consistency estimates were calculated, r = .91, based on the split half method.

Decoding. Students' decoding skills were assessed by the Word Attack subtest from the WJ-III, a pseudoword reading task administered according to standardized procedures. Testing was discontinued when students made six consecutive errors. Raw scores were converted to standard scores (M = 100, SD = 15) based on the WJ-III normative sample. Split half reliability was calculated as r = .89.

Sight word reading. Adams and Huggins (1985) list of 50 atypically spelled words was administered to students. These sight words do not follow basic spelling-sound rules and are graduated in difficulty (e.g., sugar, aisle, ocean). Words were printed in 12-point font and were presented to students in two columns on one 8.5- by11-in card. Students were asked to read each word aloud going down the list, following the order of gradual difficulty. All words were administered. Scores for accuracy and completion time were recorded. Internal consistency estimates for the accuracy scores on this task were calculated based on Cronbach's alpha, α = .72.

Rhyme word detection. Similar to Greenberg et al. (2002), an adapted Levinthal and Hornung's (1992) task was administered. Students were presented 144 word pairs and were asked to circle the pairs that rhymed. Words were matched for word length and were counterbalanced into four conditions that varied in respect to orthographic and phonological similarity. The four conditions were (1) rhyme only (coal-pole); (2) rhyme-orthographic (weed-need); (3) word-orthographic (wash-cash); and (4) dissimilar (best-card). Words were of medium frequency, based on Carroll, Davies, and Richman (1971) norms; four letters in length and all word pairs were semantically unrelated. Scores for accuracy across each condition and completion time were recorded for each student. Internal consistency estimates based on Cronbach's alpha for the accuracy scores were calculated at α = .64 (rhyme only); α = .72 (rhyme-orthographic); α = .68 (word-orthographic); and α = .76 (dissimilar).

Lexical decision. Students were presented a series of word pairs and were asked to circle the word that "looks like a real word, or could be a real word." This is the task used by Siegel, Share, and Geva (1995) and required 17 pairs of pronounceable pseudowords. One word from each pair contained a bigram (i.e., letter pair) that never occurs in English (e.g., wolg), and the other word from the pair contained an orthographically legal bigram (e.g., wolt). Scores for accuracy and completion time were recorded for each student. Internal consistency was calculated based on Cronbach's alpha for the accuracy scores at α = .82.

Spelling Measures

Spelling in isolation. The Spelling subtest of the WJ-III was administered according to standardized procedures. This task consists of 59 words that gradually become more difficult in terms of spelling-sound regularity and frequency. Students were orally presented the word once in isolation, once in a sentence, and again in isolation. Testing was discontinued when students made six consecutive errors. Raw scores were converted to standard scores (M = 100, SD = 15) based on the WJ-III norms. A split half reliability estimate of r = .91 was calculated.

Spelling error analysis. Students' misspellings from the WJ-III Spelling subtest were subjected to an error analysis based on Lennox and Siegel's (1994) scoring system that assesses misspellings according to their phonological (unconstrained and

constrained) and orthographic approximations to target words. The author and a trained research assistant scored and coded misspellings into the different categories.

Phonological scoring. The "unconstrained" scoring criteria involved scoring the accuracy for the phonological accuracy of misspellings that sounded like the target word through the application of grapheme-phoneme correspondence rules. Scores were based on the maximum number of phonemes accurately represented and in the correct order in relation to the total number of phonemes in the words (e.g., spelling/grat/for/great/ would be scored accurately under this system). Mean scores across students were calculated with a high inter-rater reliability estimate, r = .92. The "constrained" scoring condition involved the evaluation of the phonological accuracy of misspellings that sounded like the target word through the application of grapheme-phoneme correspondence rules *and* positional constraints on pronunciation. This system may be considered a more stringent measure of phonological accuracy because students needed to produce spellings with knowledge of both letter-sound relationships as well as positional rules (e.g., the spelling/grat/ would not be scored accurately but /grate/ would, since the /e/ at the end presents a phonological constraint on the /a/ to be pronounced). Mean scores were calculated across students with a strong inter-rater reliability estimate, r = .95.

Orthographic scoring. Scores were also derived based on the percentage of bigrams and individual letters that students' misspellings shared with the target word. For example, the word /bat/ has two bigrams /ba/ and /at/ and three letters for a total of five. The spelling /bt/ has no bigrams and two letters that match the target word, for a total of two. The misspelling /bt/ would therefore yield a score of 2/5 or .40. Mean scores were calculated across students with a strong inter-rater reliability estimate, r = .96.

Vocabulary and Memory Measures

Expressive oral vocabulary. The Vocabulary subtest of the Wechsler Adult Intelligence Scale, 3rd Edition (WAIS-III, Wechsler, 1997), was administered under standardized procedures to assess students' expressive vocabulary skills. Raw scores were converted to standardized scaled scores (M = 10, SD = 3), based on the WAIS-III normative sample. A split half reliability of r = .88 was calculated.

Verbal span and verbal working memory. The Digit-Span subtest of the WAIS-III was administered according to standardized procedures. This task is made up of two components: digit-span forward (a measure of verbal span), and digit span backward (a measure of verbal working memory). On the forward task, students repeated increasingly longer number sequences verbatim. On the backwards task, students listened to increasingly longer-number sequences and were required to repeat them back to the examiner in the backward order. The appropriate starting and stopping points as described in the administration manual were followed and scaled scores were used. Raw scores were converted to standardized scaled scores (M = 10, SD = 3), based on the WAIS-III normative sample. A strong internal consistency estimate was calculated: r = .87, based on the split-half method.

Phonological Processing

Phoneme deletion. The task used in other studies with adults (e.g., Snowling, Nation, Moxham, Gallagher, & Frith, 1997; Wilson & Lesaux, 2001) was administered to participants. A spoken pseudoword was presented and students were required to

repeat the word, omitting a sound (e.g., say /fleg/, now say /fleg/ without the /g/). A total of 24 items were administered following 3 practice trials, and total raw scores were recorded. Internal consistency was calculated using Chronbach's alpha, $\alpha = .76$.

Phoneme fluency. Phoneme fluency was assessed using the task developed by Snowling, Nation, et al., (1997). Students were required to name aloud as many words as possible beginning with a specified sound using the phonemes /m/, /d/, and /s/. The score was the average number of words generated in 30 seconds across the three phoneme trials.

Rapid Automatized Naming

Numeric-RAN. The RAN-Digits subtest from the Comprehensive Test of Phonological Processing CTOPP (Wagner, Torgesen, & Raschotte, 1999) was administered according to standardized procedures. Students were presented with a random display of digits from 0 to 9 and were required to quickly and accurately name aloud as many digits as possible. Two trials were administered, and the completion time for each trial was summed. Scaled scores ($M = 10$, $SD = 3$), based on the CTOPP normative sample, were recorded. Test re-test reliability for this task, as reported in the test manual, is high, $r = .89$.

Alpha-RAN. The RAN-Letters subtest from the CTOPP was administered according to standardized procedures. Students were presented with a random display of letters and were required to quickly and accurately name aloud each letter in order. Two trials were administered, and the completion time for each trial was summed and converted to a scaled score (($M = 10$, $SD = 3$) for each student. High test re-test reliability ($r = .91$) for this task is reported in the test manual.

Writing Measures

Handwriting Fluency. Students copied a narrative text as quickly and as accurately as they could within 90 minutes. This is the measure used by Hoskyn and Swanson (2003) in their research on working memory and writing in adults. The total number of words written legibly and accurately within 90 seconds was recorded.

Essay. Students completed the Essay task (Prompt A) from the WIAT-II. This task is a norm-referenced direct measure of expository writing, similar to the kind of writing tasks undergraduates may be required to complete in their course work. Good reliability estimates are reported in the WIAT-II manual, based on inter-rater ($r = .87$) and test-re-test ($r = .77$) reliability. The task was administered according to standardized procedures described in the test manual. Each essay was handwritten by students, then transcribed via the word processor maintaining errors in spelling and punctuation as well as any cross-outs in order to control for bias in essay quality associated with poor handwriting (Graham & Weintraub, 1996).

Essay scoring. Essays were scored based on the analytic scoring criteria as described in the WIAT-II test manual. Two raters who were blind to the essay writer's group membership (i.e., writing difficulties/no writing difficulties) and who were fully trained in the administration and scoring procedures for the WIAT-II scored the essays. Scores across the lower (i.e., mechanics) and higher levels (i.e., organization, vocabulary) were recorded. For example, for Mechanics (max. 9), scores were based on the number of spelling and punctuation errors of the written text. The number of spelling errors and punctuation errors were converted to quartile scores, based on the WIAT-II standardization sample. The Organization

total score (max. 17) was based on such elements as sentence structure, sequencing, and whether an introductory sentence or paragraph was evident. The Vocabulary (max. 7) score provided a measure of lexical diversity. A high inter-rater agreement was established across the essay assessment with estimates ranging from 88% (Organization) to 96% (Mechanics), consistent with the published inter-rater reliability estimates in the WIAT-II manual. For each student, raw scores were recorded across each of the three areas (mechanics, organization, and lexical diversity). Essay total word count was also recorded.

Procedure

Each participant was tested individually on the full battery of measures in one session of about 90 minutes in a quiet university research lab. Tasks were administered in counterbalanced order across four blocks (i.e., reading, spelling, cognitive processing, and writing) with a fixed order of presentation within blocks.

Results

Performance Differences on the Reading, Spelling and Cognitive Measures

The means and standard deviations for the scores across the reading and spelling measures (excluding the spelling error analysis) for each group were calculated and are presented in Table 1. Students' performance across the battery of measures was subjected to univariate analysis of variance (ANOVA) with Bonferroni correction. According to Cohen (1988), effect sizes of .01, .06, and .14 represent small, medium, and large values of eta-squared (η^2) respectively, and effect size estimates are also presented in Table 1. Only large effect sizes were detectable ($\alpha = .05$, $\beta = .80$) based on the present sample size ($n = 42$) (Faul, Erdfelder, Lang, & Buchner, 2007). Significant differences were indicated on the measure of sight word reading accuracy $F(1, 40) = 6.97$, $p < .01$; $\eta^2 = .15$ and sight word reading time $F(1, 40) = 9.74$; $p < .001$; $\eta^2 = .32$. The students with writing difficulties were less accurate and required more time to complete the sight word reading task than the students without writing difficulties. Significant differences between groups were also found for students' accuracy on the rhyme word detection task in two of the four conditions: orthographically similar, phonologically different words $F(1, 40) = 6.69$, $p < .01$ $\eta^2 = .14$, and orthographically different, phonologically similar words $F(1, 40) = 8.53$, $p < .001$ $\eta^2 = .17$. Students with writing difficulties were less accurate in detecting rhymes for visually similar non-rhyming targets (e.g., tour-hour) and for visually dissimilar, rhyming targets (e.g., door-pour). There were no significant differences between the groups on the word-recognition (letter-word identification) and decoding (word attack) tasks and on spelling in isolation (WJ-III Spelling).

Table 1

Performance on the Reading and Spelling Measures Across Groups

Measures	Writing Difficulties[a]			No Writing Difficulties[b]			
	M	*SD*	Range	*M*	*SD*	Range	η^2
WJ-III Letter-Word Ident.	104.10	4.48	(91-119)	105.09	6.53	(95-116)	.005
WJ-III Word Attack	98.80	8.47	(84-111)	101.36	5.0	(95-113)	.035
Sight Word Reading	95.20	6.10	(76-100)	98.77	1.68	(94-100)	.150
Sight Word Reading (*time)*	46.90	12.05	(30-74)	32.05	4.06	(25-44)	.320
Rhyme-word Detection							
OSPD	83.25	17.50	(29-100)	93.86	7.63	(69-100)	.140
OSPS	92.40	17.57	(31-100)	98.91	1.97	(94-100)	.067
ODPS	84.35	18.61	(37-100)	96.27	4.32	(82-100)	.170
ODPD	99.70	1.34	(94-100)	99.73	1.27	(94-100)	.000
Ortho. Conventions	89.20	9.46	(63-100)	96.27	4.28	(82-100)	.185
Ortho. Conventions (*time*)	65.80	9.35	(30-98)	40.14	9.89	(22-63)	.176
WJ-III Spelling	109.50	9.43	(93-127)	107.64	7.73	(90-124)	.009

Note. WAIS-III = Wechsler Intelligence Scale for Adults-3rd Edition; WJ-III = Woodcock Johnson Tests of Achievement-3rd Edition; OSPD = visually-similar, non-rhyming; OSPS = visually similar, rhyming; ODPS = visually dissimilar, rhyming; ODPD = visually dissimilar, non-rhyming; Ortho. (orthographic); time measured in seconds; [a] *n*=20 [b] *n*=22.

Descriptive statistics (means and standard deviations) and effect sizes for the cognitive processing measures are presented in Table 2. Significant differences were found between groups for alpha-RAN $F(1, 40) = 13.012$, $p < .001$ $\eta^2 = .24$ with the students with writing difficulties achieving significantly lower scores. No other significant differences were found.

Table 2

Performance on the Cognitive Processing Measures Across Groups

Measures	Writing Difficulties[a]			No Writing Difficulties[b]			
	M	*SD*	Range	*M*	*SD*	Range	η^2
WAIS-III Vocabulary	11.75	2.48	(8-16)	12.05	2.12	(8-17)	.004
WAIS-III Digit Span (*Dsf)*	10.20	1.88	(7-13)	11.36	2.48	(6-16)	.059
WAIS-III Digit Span (*Dsb*)	7.35	2.00	(4-11)	8.41	1.94	(5-11)	.070
Phonological Deletion	21.15	3.39	(8-24)	22.32	1.49	(20-24)	.036
Phonological Fluency	30.25	8.30	(13-49)	33.64	6.63	(23-49)	.051
Numeric-RAN	9.75	2.52	(6-15)	11.27	2.20	(5-15)	.097
Alpha-RAN	8.15	2.66	(3-13)	10.86	2.21	(7-16)	.245

Note. WAIS-III = Wechsler Intelligence Scale for Adults-3rd Edition; *Dsf* = Digit Span forward; Dsb = Digit Span backward; RAN = Rapid Automatized Naming [a] *n*=20 [b] *n*=22.

Performance Differences on the Writing Measures

Table 3 depicts the descriptive statistics and effect size estimates for the writing measures (i.e., handwriting fluency, essay word count, and lower order and higher order essay writing skills). Univariate ANOVAs with Bonferroni correction indicated significant differences between groups for writing fluency $F(1, 40) = 40.53$, $p < .0001$ $\eta^2 = .50$; essay word count $F(1, 40) = 5.29$, $p < .02$ $\eta^2 = .11$; mechanics $F(1, 40) = 13.632$, $p < .001$ $\eta^2 = .25$; organization $F(1, 40) = 64.40$, $p < .0001$ $\eta^2 = .61$, and lexical diversity $F(1, 40) = 56.87$, $p < .001$ $\eta^2 = .58$. As seen in Table 3, students with writing difficulties were less fluent in writing and produced less text of poorer quality across both lower-order (mechanics) and higher-order (organization, lexical diversity) aspects, compared to typical writers. The fact that the students with writing difficulties produced more spelling errors and used less sophisticated vocabulary in their essays than the typically-achieving writers is noteworthy, considering that no group differences were found when spelling accuracy was assessed in isolation or were any group differences detected for oral vocabulary.

Table 3
Performance on the Writing Measures Across Groups

Measure	Writing Difficulties[a]			No Writing Difficulties[b]			
	M	*SD*	Range	*M*	*SD*	Range	η^2
Handwriting Fluency	31.75	6.59	(22-42)	42.31	3.96	(33-50)	.503
WIAT-II Essay							
Essay word count	150.35	48.52	(76-255)	180.77	36.87	(148-269)	.112
Mechanics (max=9)	5.55	2.19	(2-9)	7.54	1.22	(5-9)	.254
Organization (max=17)	7.30	2.22	(2-10)	12.64	2.08	(8-16)	.617
Lexical Diversity (max=7)	1.90	.91	(0-4)	4.95	1.58	(2-7)	.587

[a] *n*=20 [b] *n*=22

Spelling Error Differences Between Groups

Differences were detected between groups in the analysis of spelling errors from the WJ-III Spelling subtest. The means and standard deviations for the scores achieved by students on the spelling error analysis are presented in Table 4 along with estimates of effect size. No significant differences were found between groups on the basis of the phonological approximation of misspellings to target words across unconstrained and constrained scoring criteria ($p = .15$ and $p = .39$, respectively), consistent with assessed phonological processing skills. However, significant differences in the number of orthographic errors were detected $F(1, 40) = 29.76$, $p < .0001$ $\eta^2 = .42$. The students with writing difficulties made less orthographically plausible misspellings than the students without writing difficulties. Thus, while students did not differ in the accuracy of their spelling in isolation, they did differ in the quality of their misspellings, with the students with writing difficulties rendering more orthographically implausible spelling errors than the group without writing difficulties.

Table 4
Means and SDs Across Groups and Spelling Error Analysis Scoring Criteria

	Phonological Accuracy						Visual/Orthographic Accuracy		
	Unconstrained			Constrained					
Group	*M*	*SD*	η^2	*M*	*SD*	η^2	*M*	*SD*	η^2
WD	94.0	9.2		91.4	9.64		67.95	8.87	
NWD	97.18	4.0		93.45	5.35		81.93	7.74	
			.051			.018			.427

Note: WD = writing difficulties; NWD = no writing difficulties

Discussion

A lack of automaticity in transcription constrained the quantity and quality of the essays written by postsecondary students with writing difficulties in accordance with previous research based on capacity models of writing. The students with writing difficulties were less fluent in writing, produced less text, and made more spelling and punctuation errors than the students without writing difficulties. Organization in writing suffered as a consequence of these difficulties with lower-order processes, as did the quality of vocabulary students used in their essays, despite well-developed oral vocabulary and spelling in isolation skills. The essay task used in this study required students to spontaneously write a persuasive essay, a task similar to the writing requirements in undergraduate classes. Students were free to choose words they knew how to spell, yet despite this freedom they made more spelling errors in text, a finding consistent with research (Gregg, et al) with writing disabled college students. One cost associated with relying on easier-to-spell words may be less sophisticated written vocabulary (Wengelin, 2005). This profile of writing performance is consistent with the documented difficulties experienced by postsecondary students with a history of LD and replicates previous findings that lower-order aspects of the writing process continue to constrain higher-order writing skills into adulthood. This profile of performance was replicated in the present sample of students who did not have a current formal diagnosis of an LD, but who identified their writing difficulties through self-report.

The students with writing difficulties were also slower and less accurate than typical writers on some of the word-level reading and naming speed tasks, but performed similarly to the typical writers on the phonological processing, decoding, and word recognition tasks. Differences in reading-related skills were evident between the groups on the Adams and Huggins' measure of sight word reading accuracy and fluency, as were differences in making rhyming decisions for words that either (1) looked alike but did not rhyme (e.g. wash-cash), or (2) rhymed, but did not look alike (door-pour). Perfetti's (2007) description of the representational properties of words, particularly a word's orthographic and phonological properties and the consequences of lexical quality, may provide insight into these word-level reading difficulties. According to the lexical quality hypothesis LQH (Perfetti & Hart, 2002), low- quality phonological and orthographic representations lead to less stable and asynchronous activation and retrieval of word constituents in reading. Accuracy and

fluency in reading the sight words required efficient retrieval of the lexical representation of words from memory, since employing letter-sound rules to decode the words would not suffice. Likewise, deciding whether two words rhyme when words differ in their visual or phonological similarity may rely on fairly sophisticated high-quality representations involving tightly connected phonological, orthographic, and semantic features as described by Perfetti and Hart (2002). Also consistent with the LQH, rapid naming is considered a by-product of lexical quality. In the present study, variation in rapid letter naming, but not rapid digit naming distinguished students with and without writing difficulties. The fact that the students with writing difficulties were differentiated from the typically-achieving writers (1) on some specific word-level reading measures *and* (2) in rapidly retrieving letter names signifies important variation in component reading skills between the two groups. While the LQH has been offered as an explanation for variation in text comprehension, the present results raise the possibility that this theory may also be valuable in explaining variation in text *production*, especially when the relationship between reading and writing in literacy is considered (e.g., Fitzgerald & Shanahan, 2000). For undergraduates with a history of learning difficulties and persistent writing problems in comparison to their counterparts without writing difficulties, findings indicate a relationship between (1) the lower *quality* of lexical representations of word constituents in reading (as assessed by the sight word reading task for accuracy and speed and in making rhyming decisions between words that vary in their orthographic and phonological similarity) and (2) the lower *quality* of their written output. A theoretical contribution made by the present study is the connection between lexical quality in reading to writing quality across both transcription and translation processes in academically at-risk adults. These findings are also consistent with the importance of word-specific knowledge within the functional writing system as described by Berninger and Amtmann, 2003.

While no deficits in spelling in isolation were found, spelling error analysis indicated that students with writing difficulties produced less orthographically plausible misspellings than the typical writers, another possible indication that word-specific lexical knowledge has not been well consolidated. These findings are consistent with the reported similarities in error patterns between adults with a history of LD and younger dysgraphic children (e.g., Gregg et al., 1988). Such error patterns may be considered the by-product of a mental lexicon that has not fully amalgamated a rich store of graphophonemic connections perhaps because of earlier phonological processing deficits and reduced print exposure (Ehri, 1986). Many of the students with writing difficulties reported that they had experienced early reading difficulties and received some form of special education during their K–12 school years. The present study highlights the continued important relationship between reading and writing component skills into adulthood, and elucidates particular profiles of adults with literacy-based learning difficulties. In particular, reading and reading-related deficits in academically at-risk adults with writing difficulties may be subtle and indiscernible on norm-referenced assessments of word recognition, decoding, and phonological processing, but evident when reading measures capturing the phonological and orthographic aspects of words along a continuum are used (such as through the measures of sight word reading and rhyme judgment used in the present study) in addition to measures of rapid automatized naming, especially for letters (i.e., alpha-

RAN). These findings have important implications for how assessments to identify learning difficulties in post-secondary populations are operationalized.

Several limitations in the study are acknowledged. The relatively small sample size limited the statistical analyses and power in detecting effects (regardless of how trivial) of small or medium magnitude (Cohen, 1992). Further research with more participants is warranted in order to replicate the findings. Because of time constraints, no measures of reading comprehension were administered that may have shed further insight into the relationship between reading and writing component skills. Participants were also English-speaking Canadian post-secondary students who had attended elementary and secondary schools in Canada; therefore, the research findings may not generalize beyond these educational and linguistic contexts.

Self-report has been described as an effective and ecologically valid method to screen for literacy-based learning difficulties in adults for research purposes (McGonnell, Parilla, & Deacon, 2007) and can reliably identify adults with writing difficulties (Smith, 1993). Since there is a high demand for writing in postsecondary assessments, students with writing problems are at risk for poor academic outcomes. The students with writing difficulties obtained written expression scores below the 25th percentile on the WIAT-II and a large proportion historically had received special education, yet only a few (20%) had actually received a formal diagnosis of a learning disability. Clearly, there are challenges faced by the schools in ensuring access to appropriate assessment services. Without a formal diagnosis (and a description of functional limitations linked to the LD), students will be unable to access accommodations for their writing difficulties (e.g., extra time for essay exams). Screening early for writing difficulties, especially in high school before the transition to postsecondary, and providing effective interventions may prevent or at least reduce the academic impact of students' writing difficulties. The fact that some aspects of word-level reading and rapid naming are also less well developed raises the possibility that early interventions aimed at enhancing lexical quality in reading may also enhance automaticity in writing. Longitudinal research that examines trajectories in component reading *and* writing skills development and sources of difficulty in children and adolescents is needed to effectively inform the adult expression of written language difficulties.

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