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Latent profiles of writing-related skills, knowledge, and motivation for elementary students and their relations to writing performance across multiple genres

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ABSTRACT

Our goal in this study is to expand the limited research on writer profile using the advantageous model-based approach of latent profile analysis and independent tasks to evaluate aspects of individual knowledge, motivation, and cognitive processes that align with Hayes' (1996) writing framework, which has received empirical support. We address three research questions. First, what latent profile are observed for late elementary writers using measures aligned with an empirically validated model of writing? Second, do student sociodemographic characteristics—namely grade, gender, race, English learner status, and special education status—influence latent profile membership? Third, how does student performance on narrative, opinion, and informative writing tasks, determined by quality of writing, vary by latent profile? A five-profile model had the best fit statistics and classified student writers as Globally Weak, At Risk, Average Motivated, Average Unmotivated, and Globally Proficient. Overall, fifth graders, female students, White students, native English speakers, and students without disabilities had greater odds of being in the Globally Proficient group of writers. For all three genres, other latent profile were significantly inversely related to the average quality of papers written by students who were classified as Globally Proficient; however, the Globally Weak and At Risk writers were not significantly different in their writing quality, and the Average Motivated and Average Unmotivated writers did not significantly differ from each other with respect to quality. These findings indicate upper elementary students exhibit distinct patterns of writing-related strengths and weaknesses that necessitate comprehensive yet differentiated instruction to address skills, knowledge, and motivation to yield desirable outcomes.

1. Introduction

Writing is a complex activity that occupies an ill-defined problem space; that is, the end result often is not fully evident to the writer beforehand and there are multiple paths available to the writer to attain the end result. It involves multiple component skills, varied forms of knowledge, and motivational attributes that must be carefully orchestrated to attain one's writing goals and communicate effectively with one's readers. An influential model of writing that encapsulates these elements (and more) is that proposed by Hayes (1996). In Hayes' model, elements of the task environment, both social (e.g., the audience, collaborators, cultural norms) and physical (e.g., the composing medium, text already produced, source materials), interact with the individual writer's cognitive processes, affective stance, and knowledge resources, which are coordinated within a limited capacity working memory system that relies on phonological and visuospatial information managed by a central executive. Relevant cognitive processes, according to Hayes, include text interpretation (i.e., mental representations of the text using available inputs), reflection (i.e., inferencing, problem solving, and decision making), and production (i.e., generation of content using any modality of expression). Affective stance involves specific rhetorical, social, and personal goals, beliefs and attitudes related to self, the writing activity, and the task environment, intra- and interpersonal predispositions, and estimates of writing activity costs and benefits. Knowledge resources available in long-term memory entail linguistic, genre, topic, audience, and task knowledge and schemas.

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1.1. Writing knowledge resources

Available empirical evidence lends support to Hayes' (1996) model of writing. With regard to knowledge resources, for instance, students who know substantively more about a writing topic are capable of producing qualitatively superior texts than their less knowledgeable peers (e.g., Benton et al., 1995; DeGroff, 1987; Langer, 1984; McCutchen, 1986; Mosenthal et al., 1985). Even when topic knowledge is derived largely from source materials, prior knowledge of the topic still exerts an influence on writing performance because it helps the writer access, select, and evaluate the information contained in the source materials (Wijekumar et al., 2019). Genre knowledge, likewise, has been found to be positively correlated with writing performance across genres and ages (e.g., Englert et al., 1988; Malpique & Veiga-Simão, 2016; Saddler & Graham, 2007) and, in multivariate studies, genre knowledge is a significant unique predictor of writing (e.g., Fidalgo et al., 2008; Olinghouse & Graham, 2009; Olinghouse et al., 2015). Of note, Gillespie et al. (2013) found that fifth graders' had different levels of writing knowledge depending on the genre, with narrative writing knowledge being the most well developed, and that metacognitive writing knowledge (what Hayes refers to as task schemas, which encompass the declarative knowledge of what constitutes good writing, procedural knowledge of writing processes that can be deployed for a given task, and conditional knowledge of strategies appropriate under different writing conditions) was predictive of genre knowledge after controlling for gender, writing achievement, and students' emphasis on conventions such as grammar, handwriting, and spelling.

Linguistic knowledge, as well, has been found to be strongly associated with writing performance across genres (e.g., Schoonen et al., 2003, 2011; Trapman et al., 2018). In a recent study, Troia et al. (submitted) found (a) significant positive correlations of 0.40 to 0.63 between scores on four alternate versions of a multiple-choice discourse knowledge (genre plus metacognitive) test and writing quality in narrative, opinion, and informative papers written by fourth and fifth graders and (b) significant positive correlations of 0.59 to 0.67 between scores on four alternate versions of a multiple-choice test of writing mechanics knowledge (i.e., linguistic knowledge related to grammar, spelling, capitalization, and punctuation) and writing quality in the three genres. Moreover, the combination of the two types of knowledge explained between 36 % and 49 % of variance in writing quality across genres, depending on the test version.

1.2. Writing motivation and affective stance

In line with Hayes' (1996) model, varied aspects of human motivation have been shown to greatly influence writing performance (see Camacho et al., 2021). Even when initial writing competence (which also accounts for the prior influences of motivation), grade, and gender are controlled, self-efficacy (i.e., task competency) beliefs still make a significant independent contribution to variance in writing outcomes (Graham & Harris, 1989; Pajares et al., 1999; Pajares & Valiante, 1997; Zimmerman & Bandura, 1994). There is a distinction between self-efficacy beliefs related to writing skills versus writing tasks, with skills-related efficacy beliefs being more consistently related to writing quality (e.g., Karaglani, 2003; Pajares & Johnson, 1994, 1996). Measures of self-efficacy for writing skills encompass features associated with virtually any composing task (e.g., spelling, punctuation, adding details, planning effectively), whereas measures of self-efficacy for writing tasks (e.g., writing a persuasive argument versus writing an enjoyable fictional story) may address a variety of tasks beyond the criterion writing task used to assess writing performance. Given the use of a single criterion writing task in many studies, the likelihood that diverse task-related self-efficacy items on an instrument will be related to performance on the task is diminished.

Aside from efficacy beliefs, task interest appears to have a facilitative effect on writing performance (Albin, Benton, & Khramtsova, 1996; Benton, Corkill, Sharp, Downey, & Khramtsova, 1995). Personal interest in a task or domain tends to be stable because it arises from individual preferences or predispositions, whereas situational interest arises from specific task characteristics (Hidi, 1990; Hidi & Baird, 1986; Hidi & Harackiewitcz, 2000); thus, an individual may have little interest in writing stories, but an assignment that specifies writing a first-person narrative of a personal hero may spark their interest. Interest reflects, in part, the personal significance or value attached to a task (Schiefele, 1999; Wigfield & Eccles, 1992). According to Eccles (1987), value can be broken down into attainment value (i.e., the relevance of the task), intrinsic value (i.e., the extent to which the task presents a challenge, invites curiosity, and permits a sense of control and mastery), utility value (i.e., the importance of the task), and cost (i.e., how much anxiety, effort, and loss are associated with the task). Interest and value, though related, can operate rather independently (Eccles, Wigfield, & Schiefele, 1998). Thus, an individual might be interested in a task but assign relatively little value to it or, conversely, view a task as highly valuable but have little interest in it. In conjunction with self-efficacy beliefs, task interest and value influence the selection of goals (Eccles, 1987; Hidi et al., 2002; Pervin, 1983; Wigfield & Eccles, 1992).

Troia and colleagues (2013) examined the direct and indirect contributions of grade, gender, teacher judgment of overall writing ability, writing activity (how often students engaged in particular writing activities in and out of school over the previous month), and writing motivation (a combination of items tapping writing skill- and task-related efficacy beliefs, personal task interest and attainment value, and attributions for writing success) on fictional narrative writing quality for over 600 students in grades 4 through 10, excluding grade 8. Teacher judgment of overall writing ability and writing activity directly influenced writing motivation (grade and gender had indirect effects), while grade, teacher judgment of overall writing ability, and writing motivation exerted a direct positive influence on narrative quality (gender and writing activity had indirect effects). For every standard deviation increase in writing motivation, there was approximately-two-tenths of a standard deviation increase in narrative quality when controlling for other predictors in the model.

1.3. Writing cognitive processes

The cognitive processes associated with writing identified by Hayes (1996) are perhaps the most well studied predictors of writing outcomes. Text production is largely predicated on transcription skills (e.g., spelling, handwriting, keyboarding) and translation skills (converting thoughts into language). The importance of transcription is demonstrated by studies in which handwriting and typing fluency and both isolated and contextual spelling proficiency have been found to explain a significant portion of variance in handwritten and typed composition quality and quantity across different genres throughout grade school (e.g., Bourdin & Fayol, 2002; Connelly et al., 2007; Feng et al., 2019; Graham et al. 1997; Jones & Christensen, 1999; Kent & Wanzek, 2016; Puranik & Al Otaiba, 2012; Troia, Brehmer, Glause, Reichmuth & Lawrence, 2020; Wagner et al., 2011). Translation involves the application of knowledge resources to craft text, especially linguistic knowledge about word- and sentence-level information, and thus adeptness with manipulating vocabulary and grammar is related to writing performance. For instance, better writers typically employ more diverse and sophisticated vocabulary in their compositions (e.g., Chipere et al., 2001; Koutsoftas & Petersen, 2017; McNamara et al., 2010; Silverman et al., 2015) and are more accurate in their grammar usage (e.g., Dockrell et al., 2009; Mackie & Dockrell, 2004; Nelson & Van Meter, 2007; Puranik et al., 2008; Scott & Windsor, 2000; Windsor et al., 2000).

Text interpretation depends heavily on one's reading abilities, which have been found to influence both text length and quality (Abbott & Berninger, 1993; Berninger et al., 2002; Kent & Wanzek, 2016). Reflection permits writers to personalize writing and the associated actions they employ to produce a text, make inferences about their

readers, source materials, and collaborators, and plan and revise their texts. In particular, both planning and revising have been found to be important to successful writing and, when taught and used, to be related to better text structure, longer papers, and higher quality (e.g., Brodney, Reeves, & Kazelskis, 1999; De La Paz & Graham, 1997; De La Paz, Swanson, & Graham, 1998; MacArthur & Philippakos, 2010; Moore & MacArthur, 2012; Saddler, 2006; Sawyer, Graham, & Harris, 1992; Tracy, Reid, & Graham, 2009; Troia & Graham, 2002; Troia, Graham & Harris, 1999; Wong, Butler, Ficzere, & Kuperis, 1996, 1997).

1.4. Profiles of writers

There is no universal profile that characterizes normal or atypical writing performance and development; in fact, research suggests that, much like for reading, there are distinct profiles of writers, though the paucity of research has impeded the replication of specific profiles. In an early study by Roid (1994), who employed hierarchical agglomerative cluster analysis to derive 11 subtypes of writers based on six analytic rubric trait scores from students enrolled in grades three and eight, one cluster included approximately one-fifth of the students who scored one standard deviation or more above the mean on all traits, and another included about the same number of students who scored one standard deviation or more below the mean on all traits. The remaining clusters showed different patterns of strengths and weaknesses on the six traits of ideas, organization, voice, word choice, sentence fluency, and conventions. Weiss et al. (2019) identified five clusters using writing curriculum-based measures (including total words written, words spelled correctly, and correct word sequences) derived from narrative papers written in response to prompts administered in the fall, winter, and spring to 324 third- and fourth-grade students. The clusters, derived using distance-based cluster analysis, represented: (1) low initial performance followed by a high rate of change, (2) low initial performance followed by a modest rate of change, (3) moderate initial performance followed by a high rate of change, (4) moderate initial performance followed by a variable rate of change depending on the particular measure, and (5) high initial performance followed by a minor rate of change.

In studies where independent tests of literacy, language, and cognition were used to help develop profiles (rather than relying solely on data derived from informal writing samples), even more numerous and distinct subgroups are seen. For instance, Wakely, Hooper, de Kruif, and Swartz (2006) identified six different linguistically-based writing clusters for 262 fourth- and fifth-grade students, with subtypes reflecting both normal and atypical development. Normal developmental variation was captured in two reliable profiles, one consisting of average writers and another of expert writers who had the highest writing and reading scores among students and made virtually no grammatical, semantic, or spelling errors when writing. Atypical writing development was captured in four reliable profiles, ranging from a subgroup that exhibited global impairments in language skills to three subgroups experiencing more specific linguistic impediments, such as a greater number of semantic errors, greater number of grammatical errors, or low reading and spelling performance. Likewise, Hooper et al. (2006) used cluster analytic procedures with 73 grade four and five children to yield seven reliable clusters based on multiple measures of executive functions, attention, working memory, and oral language: four normal variants, one cluster with notable problem solving weakness, one with problem solving plus oral language weaknesses, and one cluster with relative problem solving and oral language strengths. Coker and his colleagues (2018) evaluated 391 first graders at the end of the school year with tests of spelling accuracy, sentence writing (using three provided words) fluency, and sentence writing (in response to picture and verbal cues) quality. They used latent profile analysis rather than cluster analysis, which has the advantage of being a more flexible model-based approach and classifies individuals based on profile membership probabilities and not cluster affiliation or non-affiliation. The students fit one of five latent profiles based on their performance on the three tests administered: globally above average, globally average, at-risk, low fluency, and low writing quality. The students also wrote narrative and descriptive texts that were scored multiple ways and confirmatory factor analysis identified four common factors based on quality/length, spelling accuracy, mechanics (capitalization and punctuation) accuracy, and syntactic complexity. Students in the at-risk subgroup wrote narratives and descriptions that scored lower on all aspects of writing when compared to students in the average and above average subgroups, while the above average subgroup wrote papers that scored higher on all aspects of writing than the average and at-risk subgroups.

1.5. Research objectives for this study

Our goal in this study is to expand the limited research on writer profiles using the advantageous model-based approach of latent profile analysis and independent tasks to evaluate aspects of individual knowledge, motivation, and cognitive processes that align with Hayes' (1996) writing framework, which has received empirical support. We address three research questions. First, what latent profiles are observed for late elementary writers using measures aligned with an empirically validated model of writing? Second, do student sociodemographic characteristics—namely grade, gender, race, English learner status, and special education status—influence latent profile membership? Third, how does student performance on narrative, opinion, and informative writing tasks, determined by quality of writing, vary by latent profiles?

2. Materials and methods

2.1. Participants

A total of 335 students from grades 4 (n = 156) and 5 (n = 179) participated in this study, with ages ranging from 9-0 to 11–2. These students came from 42 general education classrooms distributed throughout 24 different Midwestern U.S. schools. The students in this study were recruited at the classroom level as part of a larger study of the relationships between teachers' writing instructional practices and annual growth in their students' writing performance, knowledge, and motivation. Most of the classroom teachers of the participating students used a modified version of Calkin's (2013) units of study for teaching writing developed by an intermediate school district in which many of the participants were enrolled. Of the participants, 55 % (n = 185) were female and 71 % were White (n = 239). Additionally, about 6 % (n = 21) of the students were considered non-native English learners and 8 % were categorized as students with special needs (n = 28). These students were enrolled in the larger study in three annual cohorts between 2017 and 2020.

2.2. Measures

2.2.1. Transcription fluency

A paragraph copy task like the one developed by Monroe and Sherman (1966) was used to measure participants' handwriting and typing fluency. A paragraph of 147 words and 602 characters (pilot testing indicated the original paragraph used by Monroe and Sherman required lengthening to avoid ceiling effects) was presented on a sheet of paper with widely spaced lines below it for copying the text by hand, or at the top of a computer screen above an empty text box in which students typed the text by keyboard. The students were given 90 s to copy as much of the paragraph as possible and reminded that it was not necessary to read the text before copying it. The number of characters correctly handwritten or typed (i.e., characters accurately copied in sequence excluding additions or substitutions) in the time allotted was calculated. All students elected to copy the paragraph by hand using manuscript lettering. The typed version of the task was administered at least several days following the handwritten version. Two trained

undergraduates independently tallied the number of correctly copied characters in each task and reached at least 80 % exact agreement.

2.2.2. Writing-related component skills

The Vocabulary and Spelling & Punctuation subtests of the *Test of Written Language-Fourth Edition* (TOWL-4) were administered to participants. For the Vocabulary subtest, students are presented with a word to independently read and then write a single complete sentence using the word exactly as printed (i.e., without altering the tense or part of speech) to demonstrate an understanding of its meaning. Students were asked to complete as many items as they could, but for scoring purposes, a ceiling was reached when three consecutive errors occurred. For the Spelling & Punctuation subtest (these use the same task but yield separate scores), students transcribe dictated sentences to demonstrate their grasp of written language conventions of spelling/capitalization and punctuation. Testing was discontinued after three consecutive errors in both spelling and punctuation. Raw scores were converted to scaled scores ($M = 10$, $SD = 3$). The Vocabulary subtest has an internal consistency reliability between 0.85 and 0.92 for children the same ages as participants in our study, while the Spelling subtest's internal consistency reliability is between 0.90 and 0.92 and the Punctuation subtest's is between 0.91 and 0.93.

2.2.3. Verbal working memory

The Reversed Letters subtest of the *Detroit Tests of Learning Aptitude-4* (DTLA-4) was administered to participants to assess their verbal working memory. Students were presented increasingly longer series of two to eight random letters and asked to write the letters, in reverse order, inside corresponding boxes appearing on a record form using left-to-right sequence without any repetitions. The total number of letters placed in the correct sequence in the boxes served as the raw score, which was converted to a scaled score ($M = 10$, $SD = 3$). This subtest has an internal consistency reliability between 0.88 and 0.92 for children the same ages as participants in our study.

2.2.4. Written essay quality

Participants' typewritten texts in response to narrative, opinion, and source-referenced informative prompts were hand-scored using a rubric based on the Smarter Balanced Assessment Consortium performance task writing rubrics. The rubric contains seven dimensions: (1) reader orientation to purpose, (2) logical coherence, (3) concluding section, (4) cohesion through linking words or phrases, (5) development of ideas using details such as facts, examples, quotes, and experiences, (6) precise and varied language; and (7) correct grammar/usage/mechanics (i.e., writing conventions). Each dimension was scored on a scale of 0 (no evidence of dimensional quality, severely flawed/incomprehensible) to 5 (excellent evidence of dimensional quality, virtually no flaws/fully comprehensible) for a total score between 0 and 35. The dimension scores loaded on a single factor that accounted for 58.8 %, 61.2 %, and 61.2 % of total variance for narrative, opinion, and informative papers, respectively. Internal consistency reliabilities using the seven dimensions were 0.86, 0.88, and 0.89 for narrative, opinion, and informative papers, respectively. All of the papers were double scored by trained undergraduates and the interrater reliability estimates, calculated with a two-way random effects intraclass correlation using absolute agreement, were 0.80, 0.81, and 0.84 for narrative, opinion, and informative papers, respectively.

2.2.5. Written essay planning

For each paper typewritten in response to the narrative, opinion, and informative prompts, students' handwritten plans (see section 2.3 below) were evaluated for their degree of sophistication using a four-point scale, where 0 = no written plan, 1 = a written plan in which a portion of text that appeared in the essay was simply drafted, 2 = a written plan in which key idea words or phrases were recorded or illustrations were drawn as reminders for text to be written on the computer, and 3 = a written plan that included text structural reminders (e.g., characters and setting for stories, position and reasons for opinion essay) or elements (e.g., a graphic organizer or labeled outline) plus a drafted portion of text or key idea words/phrases or illustrations. Each plan was evaluated by two trained graduate students who reached at least 86.7 % exact agreement; disagreements were discussed to reach consensus. The planning score assigned after discussion for each genre-specific paper was used in analyses.

2.2.6. Writing knowledge

The *Student Knowledge of Writing Test* (SKOWT), a 30-item multiple choice task, was administered to participants to assess their knowledge of writing mechanics (spelling, capitalization, punctuation, and grammar items) and discourse (genre and writing process items), which were second order latent factors with adequate model fit derived through confirmatory factor analysis. Both the mechanics and discourse latent factors were substantially related to (a) performance on norm-referenced measures of writing-related skills and (b) writing quality in essays produced in response to prompts (see Troia et al., submitted). These latent factors demonstrated internal consistency reliabilities of 0.75 or greater across four cogeneric versions of the SKOWT, forms A though D. The total correct for items associated with each factor was used in analyses.

2.2.7. Writing motivation

The *Situated Writing Activity and Motivation Scale* (SWAMS) was administered to each participant. The SWAMS includes a set of 15 motivation items (the items associated with writing activity were not administered for this study) anchored to each genre of writing (narrative, opinion, and informative) using a writing assignment scenario presented before each set. All motivation items use a seven-point scale ranging from 0 (totally disagree) to 6 (totally agree), with negatively worded items (e.g., "I would not be able to come up with great ideas and include lots of details for this story") reverse scored. The items for each genre use similar structures (e.g., "I usually enjoy writing stories" versus "I usually don't like writing informative articles or papers") to assess discrete aspects of motivation, including task interest and value (four items), self-efficacy for skills and tasks (seven items), and outcome expectations for skills and tasks (four items). A series of confirmatory factor analyses demonstrated that a single motivation factor using all 15 items was appropriate, with internal consistency reliability for the factor associated with narrative-, opinion-, and informative-specific motivation of 0.86, 0.87, and 0.85, respectively (see Wang & Troia, in press). Therefore, an average value of the 15 motivation items for each genre was calculated to represent students' genre-specific motivation. There were four versions of the SWAMS, but unlike the SKOWT, these versions contained exactly the same items, but the ordering of scenarios and items associated with each scenario were rotated for each version.

2.2.8. Word reading skill

The Reading subtest of the *Wide Range Achievement Test-3* (WRAT-3) was administered to measure students' word recognition ability. Students were asked to read as many of the 42 words as possible on the test plate, which were presented in rows with increasing difficulty. Responses had to be given within 10 s and had to be correct whole-word pronunciations to be marked correct. Testing was discontinued after 10 consecutive errors. Each raw score was converted to a standard score ($M = 100$, $SD = 15$). Internal consistency reliabilities for the age group of students in this study range between 0.88 and 0.90.

2.3. Procedures

All measures were administered to groups of 6–15 students in a quiet room at their local school by a trained graduate research assistant or the first author. The TOWL-4, DTLA-4, and WRAT-3 subtests and the handwriting fluency task were administered once at the beginning of the

school year, followed within two weeks by the SKOWT and SWAMS form assigned via counterbalancing to each student and the writing prompts for narrative, opinion, and informative essays assigned via counterbalancing to each student. Students were asked to respond to the writing prompts on a computer or laptop using a web-based application called Writing Architect (Truckenmiller et al., 2020), which also included the typing fluency task following each essay prompt. Administration of the SKOWT and SWAMS always preceded administration of the essay writing prompts, and the prompts (and typing fluency task) were delivered over multiple days. Three additional administrations of alternate versions of the SKOWT, SWAMS, and writing prompts (plus the typing fluency task following each prompt) occurred approximately every-two months. For this study, data derived from multiple administrations over time of the SKOWT, SWAMS, essay writing tasks (with attendant planning), and typing fluency task were averaged to obtain a reliable estimate of these abilities.

For each writing prompt to which students responded through Writing Architect, they were given a printed copy of materials they viewed on the computer screen as well as a blank space below the printed prompt instructions for planning their papers (they were instructed to plan in whatever fashion they had been taught for the genre). Students were permitted up to three minutes to plan each paper and 15 min to write. An audible beep paired with a visual warning flashed across the top of the screen was given when one minute remained for the time allotted to writing. All instructions (and passages for informational papers, see below) were not only presented in print and on the computer screen, but also were audibly presented by the computer to help alleviate problems encountered by weaker readers. Students were provided with headphones to listen simultaneously while reading the hard copy and/or electronic versions of materials.

Each genre had four prompt options and students completed all four prompts for each genre by the end of the school year. The prompts (and task instructions noted below) were reviewed by an expert panel of writing researchers and teachers. Narrative prompts were in the form of a story title: (1) *One Day of Invisibility*; (2) *The Attack*; (3) *Fantastic Voyage*; (4) *Don't Go into The Attic*. Opinion prompts were in the form of a question: (1) *Should sugary foods be allowed at school?*; (2) *Should a person always be honest?*; (3) *Should cellphones be allowed in classrooms?*; (4) *Should families be able to pick who their children's friends are?* Informative prompts were linked to modified expository passages from online sources. The passage titles were: (1) *13-Year-Old World War II Veteran*; (2) *Swat Up: Six Reasons to Love Flies*; (3) *Can an Elevated Bus Solve China's Traffic Woes?*; (4) *Plastic Bottle Village*. Permission was obtained from the copyright holders to use and modify the passages for research. The passages were modified to be within a range of readability appropriate for grades 3 through 8 based on word count, Lexile®, Flesch-Kincaid, and Coh-Metrix degree of narrativity (below 50 % for each passage). A pilot study to evaluate the equivalence of these prompts with a sample of approximately 175 children in grades 3 through 8 found no significant differences in text length and quality (including conventions) associated with prompt in any genre.

When responding to a narrative prompt, students were told to "write a creative, fictional story—a make believe story—to match the title; write a story others will find interesting and enjoyable to read and, remember, a good story (1) establishes the setting, (2) develops the characters, (3) describes an exciting plot sequence that has a clear beginning event, character actions related to that event, and an outcome or conclusion, and (4) follows the rules of writing." When responding to an opinion prompt, students were told to "write a persuasive essay that convinces readers to agree with your answer to the question and, remember, a good persuasive essay (1) clearly states your opinion, (2) gives detailed facts and personal experiences to support your opinion, (3) has a conclusion that helps your readers understand why they should agree with your opinion, and (4) follows the rules of writing." When responding to an informative prompt, students were told to "write an informative paper that will help others learn about the topic of the passage you read; be sure to use information from the article you just read to give reasons why it is important and, remember, a well written informative paper (1) has a clear main idea and stays on topic, (2) includes a good introduction and conclusion, (3) uses information from the article stated in your own words plus your own ideas, and (4) follows the rules of writing."

2.4. Data analysis

We employed latent profile analysis (LPA) in this study using Mplus 8.3 software with robust maximum likelihood estimation. We also used the Type = Complex sandwich estimator to derive standard errors and chi-square tests of model fit that accounted for the clustering of student data within classrooms. Latent profile analysis classifies heterogeneous subgroups of similar individuals based on responses to observed continuous indicators; the indicators in this study are the measures described in section 2.2 (essay planning was dummy coded as a categorical variable; the obtained data from these measures were converted to z-scores to aid interpretation), except written essay quality, which was used as the criterion variable for the third research question posed. The LPA procedure fits a series of models (from a 1-profile model to a *k*-profile model) to the data and then compares each subsequent *k* model with the previous one ($k - 1$). The optimal model is evaluated using multiple criteria, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-adjusted BIC (SABIC) values, with lower values indicating better fit of a corresponding model. The magnitude of the change in SABIC from one model to the next also is important to consider. A complementary index for model comparison includes the *p*-value for the Lo-Mendell Rubin adjusted Likelihood Ratio Test (LMR-LRT), with a significant *p*-value indicating the new model fits better, while a non-significant *p*-value indicates the prior model fits better (Ferguson, Moore, & Hull, 2020; Nylund, Asparouhov, & Muthén, 2007). The approximate Bayes Factor (BF) is an additional index for model comparison, where $BF_{A,B}$ is the ratio of the probability of model A being the correct model to model B being the correct model when models A (*k* profiles) and B ($k + 1$ profiles) are the competing models. It is calculated as $\exp[SIC_A - SIC_B]$, where SIC = -0.05 (BIC). According to Wasserman (2000), $1 < BF_{A,B} < 3$ is weak evidence for model A, $3 < BF_{A,B} < 10$ is moderate evidence, and $BF_{A,B}$ greater than 10 is strong evidence. Conversely, $BF_{A,B} < 0.10$ is strong evidence for model B, $0.10 < BF_{A,B} < 0.33$ is moderate evidence, and $0.33 < BF_{A,B} < 1$ is weak evidence. Entropy, a measure of classification uncertainty, should be greater than 0.80 to indicate minimum uncertainty (Celeux & Soromenho, 1996; Tein et al., 2013). Five key binary demographic variables—grade, gender, race, non-native English learner status, and eligibility for special education services—were evaluated for their effects on profile membership using logistic regression. Ordinary least squares regression was used to determine how well each latent profile, dummy coded for analysis, predicted essay quality in each genre, with the profile representing the strongest performance serving as the reference profile.[1]

3. Results

Table 1 presents the means, standard deviations, and ranges for the latent profile indicators and the auxiliary criterion variables in the study, prior to z-score conversion. Correlations between all study variables are found in Table 2, as are the two-way random effects ICCs for each variable indicating the amount of variance attributable to

[1] We regressed both text length (total words written) and text quality onto latent profiles, but to conserve space only report results associated with text quality because (a) text length and quality were moderately to strongly correlated across genres (*r*s = 0.49 to 0.69) and (b) the regression outcomes for length were similar to those for quality.

Table 1
Means, standard deviations, and ranges for study variables.

Measure	Variable Label	Mean	SD	Range
Handwriting Fluency	HWFluency	104.55	29.85	24.00–234.00
Typing Fluency*	TWFluency	96.88	42.00	14.00–258.22
TOWL-4 Punctuation	Punct	11.08	2.34	4.00–17.00
TOWL-4 Spelling	Spell	9.57	2.97	3.00–17.00
TOWL-4 Vocabulary	Vocab	10.61	2.90	1.00–20.00
WRAT-3 Reading	Read	106.06	12.28	67.00–142.00
DTLA-4 Reversed Letters	WM	13.06	3.39	1.00–20.00
Planning Narrative*	NarrPlan	1.35	0.79	0.00–3.00
Planning Opinion*	OpinPlan	1.33	0.76	0.00–3.00
Planning Informative*	InfoPlan	1.21	0.77	0.00–3.00
SKOWT Mechanics*	MechKnow	12.36	3.79	2.50–18.50
SKOWT Discourse*	DiscKnow	6.55	2.20	1.00–11.00
SWAMS Narrative*	NarrMotiv	4.48	0.84	2.13–6.00
SWAMS Opinion*	OpinMotiv	4.44	0.88	1.77–5.98
SWAMS Informative*	InfoMotiv	4.45	0.85	1.20–6.00
Narrative Quality*	NarrQual	14.12	4.16	4.00–23.75
Opinion Quality*	OpinQual	13.41	4.40	4.00–25.75
Informative Quality*	InfoQual	13.17	4.52	2.50–25.75

* These values represent the mean over multiple administrations across the school year.

clustering (ranging between 0.09 and 0.26; these were calculated using R). Goodness-of-fit indices, entropy, and classification percentages and group sizes for the LPA are shown in Table 3; one to seven profile solutions were evaluated.

3.1. Derived latent profiles using theory-aligned measures

As seen in Table 3, using the combined values for the fit indices, entropy, BF, and LMR-LRT and the criteria noted in section 2.4, the five-profile solution appears to be the best option considering it has the highest entropy value associated with lower fit indices and a BF value of 0.001, although the LMR-LRT *p*-value for this model is non-significant. The five profiles are illustrated in Fig. 1, and Table 4 gives the model-based z-score means and associated 95 % confidence intervals (CIs) for all the indicator variables used to construct the profiles. The five-profile model classified student writers as Globally Weak (Profile 1), At-Risk (Profile 2), Average Motivated (Profile 3), Average Unmotivated (Profile 4), and Globally Proficient (Profile 5).

The Globally Weak profile included 12 % of the sample and these students scored between 0.8 and 1.3 standard deviations below average on most of the norm-referenced, SKOWT, and SWAMS measures and about one-half a standard deviation below average on most fluency and planning measures. The second profile, At-Risk writers, contained 27 % of the sample; these students scored about a half standard deviation below the mean on all measures except word reading (a third of a standard deviation below average), spelling (two-thirds of a standard deviation below average), working memory (average), writing mechanics knowledge (three-quarters of a standard deviation below average), and SWAMS genre-specific writing motivation (about a tenth of a standard deviation below average). The third profile, Average Motivated writers, included 25 % of the sample and these students scored between 0.1 and 0.4 standard deviations above average on most measures, though they scored somewhat relatively higher on SWAMS motivation measures and about a third of a standard deviation below average on planning. Average Unmotivated writers comprised 15 % of the sample; these students scored as well as or somewhat better than those in the third profile on most measures, including average planning performance. However, unlike the Average Motivated writers, students in this group scored below average on the SWAMS by about four-tenths of a standard deviation. Finally, the Globally Proficient profile included 20 % of the sample and these students scored between approximately 0.4 and 0.7 standard deviations above the mean on most norm-referenced, writing knowledge, and genre-specific writing motivation measures, with exceptionally strong (greater than a standard deviation

Table 2
Correlations between study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. HWFluency	1																	
2. TWFluency	0.51*	1																
3. Punct	0.35*	0.41*	1															
4. Spell	0.45*	0.58*	0.75*	1														
5. Vocab	0.34*	0.35*	0.50*	0.62*	1													
6. Read	0.25*	0.40*	0.54*	0.66*	0.61*	1												
7. WM	0.19*	0.24*	0.32*	0.37*	0.30*	0.26*	1											
8. NarrPlan	0.21*	0.18*	0.26*	0.28*	0.19*	0.14*	0.02	1										
9. OpinPlan	0.23*	0.19*	0.34*	0.33*	0.21*	0.15*	0.04	0.71*	1									
10. InfoPlan	0.26*	0.19*	0.32*	0.28*	0.17*	0.12*	0.06	0.65*	0.75*	1								
11. MechKnow	0.37*	0.50*	0.64*	0.73*	0.58*	0.54*	0.23*	0.26*	0.34*	0.31*	1							
12. DiscKnow	0.31*	0.33*	0.52*	0.58*	0.57*	0.46*	0.13	0.27*	0.34*	0.28*	0.78*	1						
13. NarrMotiv	0.22*	0.24*	0.34*	0.40*	0.35*	0.33*	0.21*	0.21*	0.30*	0.26*	0.44*	0.42*	1					
14. OpinMotiv	0.20*	0.24*	0.34*	0.38*	0.34*	0.31*	0.20*	0.24*	0.34*	0.30*	0.45*	0.44*	0.89*	1				
15. InfoMotiv	0.20*	0.23*	0.34*	0.40*	0.39*	0.33*	0.23*	0.22*	0.34*	0.30*	0.44*	0.44*	0.89*	0.90*	1			
16. NarrQual	0.50*	0.66*	0.54*	0.66*	0.58*	0.46*	0.17*	0.28*	0.35*	0.33*	0.71*	0.59*	0.37*	0.37*	0.33*	1		
17. OpinQual	0.52*	0.59*	0.58*	0.67*	0.53*	0.43*	0.19*	0.39*	0.49*	0.42*	0.70*	0.62*	0.41*	0.39*	0.38*	0.85*	1	
18. InfoQual	0.48*	0.59*	0.58*	0.67*	0.56*	0.44*	0.19*	0.31*	0.41*	0.34*	0.74*	0.64*	0.39*	0.39*	0.40*	0.81*	0.85*	1
ICC	0.12	0.21	0.09	0.13	0.14	0.11	0.14	0.16	0.21	0.14	0.15	0.17	0.11	0.09	0.10	0.26	0.22	0.24

* $p \leq 0.01$.

Table 3
LPA model fit summary.

Model	AIC	BIC	SABIC	ΔSABIC	LMR-LRT	BF	Entropy	Sample Proportions
1	14313.368	14465.934	14339.049	–	–	–	–	$P1 = 100$ % N1 = 335
2	11503.283	11697.803	11536.026	−2803.023	1343.699, $p = 0.0513$	0.000	0.906	$P1 = 43$ % N1 = 144
								$P2 = 57$ % N2 = 190
3	11105.762	11380.379	11151.988	−384.038	435.951, $p = 0.4571$	0.000	0.916	$P1 = 37$ % N1 = 127
								$P2 = 38$ % N2 = 128
								$P3 = 24$ % N3 = 80
4	10840.524	11195.239	10900.233	−251.755	304.741, $p = 0.3946$	0.000	0.909	$P1 = 23$ % N1 = 77
								$P2 = 25$ % N2 = 83
								$P3 = 18$ % N3 = 60
								$P4 = 34$ % N4 = 112
5	10613.679	11048.490	10686.871	−213.362	266.661, $p = 0.4324$	0.001	0.921	$P1 = 12$ % N1 = 41
								$P2 = 27$ % N4 = 91
								$P3 = 15$ % N5 = 51
								$P4 = 25$ % N2 = 85
								$P5 = 20$ % N3 = 67
6	10448.052	10962.959	10534.726	−152.145	205.941, $p = 0.6405$	0.012	0.911	$P1 = 10$ % N1 = 31
								$P2 = 19$ % N2 = 64
								$P3 = 18$ % N3 = 61
								$P4 = 18$ % N4 = 61
								$P5 = 15$ % N5 = 52
								$P6 = 20$ % N6 = 69
7	10322.792	10917.796	10422.949	−111.777	194.675, $p = 0.3531$	0.104	0.917	$P1 = 10$ % N1 = 32
								$P2 = 19$ % N2 = 62
								$P3 = 15$ % N3 = 50
								$P4 = 8$ % N4 = 28
								$P5 = 17$ % N5 = 59
								$P6 = 18$ % N6 = 62
								$P7 = 12$ % N7 = 42

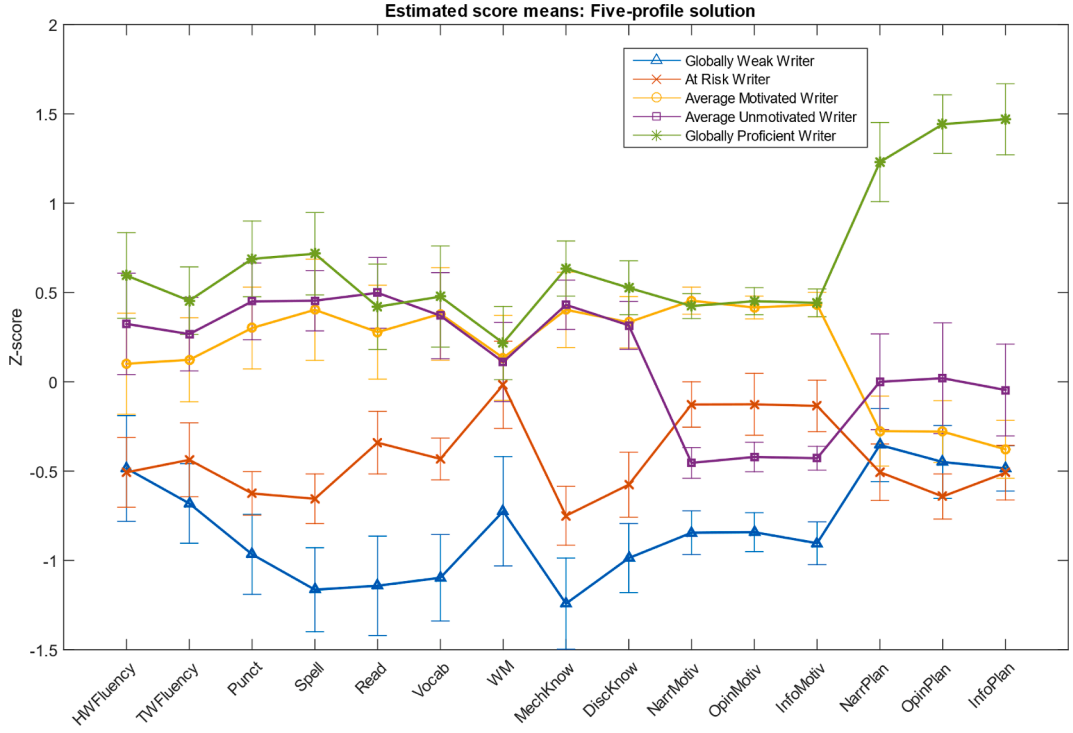

Fig. 1. Five-profile solution with estimated z-score means for each latent profile.

above the mean) planning scores.

3.2. Effects of demographics on latent profile membership

We examined the influence of five demographic variables (grade, gender, race, English learner status, and special education status) on the membership of the derived latent profiles. The fifth profile, Globally Proficient writers, was set as the reference profile. Table 5 displays the estimates of the intercepts (β_0), the regression coefficients (β_1), and related odds and odds ratios (ORs) with the 95 % CI for each OR.

Fourth graders were used as the reference category for grade. The regression coefficients were significant for Profiles 2 and 3, and the associated ORs (0.141 and 0.410, respectively) indicated that, compared with fourth graders, fifth graders had significantly reduced odds of being grouped into Profile 2 versus 5 by 85.9 %, and Profile 3 versus 5 by 59.0 %. Conversely, fourth graders had about 7.1 times increased odds of

Table 4
Indicator variable z-score means [and 95% confidence intervals] for the 5-profile solution.

	Profile 1: Globally Weak Writer (*n* = 41)	Profile 2: At Risk Writer (*n* = 91)	Profile 3: Average Motivated Writer (*n* = 85)	Profile 4: Average Unmotivated Writer (*n* = 51)	Profile 5: Globally Proficient Writer (*n* = 67)
HWFluency	−0.485 [-0.785, −0.185]	−0.506 [-0.703, −0.309]	0.100 [-0.188, 0.388]	0.324 [0.037, 0.612]	0.594 [0.351, 0.838]
TWFluency	−0.681 [-0.907, −0.455]	−0.436 [-0.643, −0.230]	0.123 [-0.146, 0.379]	0.267 [0.058, 0.476]	0.453 [0.262, 0.645]
Punct	−0.966 [-1.194, −0.739]	−0.625 [-0.747, −0.503]	0.300 [-0.002, 0.602]	0.450 [0.232, 0.669]	0.687 [0.473, 0.902]
Spell	−1.165 [-1.403, −0.927]	−0.655 [-0.794, −0.516]	0.402 [0.113, 0.691]	0.455 [0.284, 0.626]	0.717 [0.483, 0.951]
Read	−1.143 [-1.424, −0.862]	−0.341 [-0.518, −0.164]	0.277 [0.010, 0.545]	0.499 [0.299, 0.699]	0.420 [0.178, 0.662]
Vocab	−1.098 [-1.339, −0.855]	−0.432 [-0.550, −0.313]	0.379 [0.116, 0.642]	0.371 [0.128, 0.615]	0.477 [0.192, 0.763]
WM	−0.726 [-1.034, −0.418]	−0.017 [-0.265, 0.230]	0.134 [-0.107, 0.374]	0.111 [-0.114, 0.336]	0.217 [0.011, 0.424]
MechKnow	−1.242 [-1.500, −0.984]	−0.750 [-0.917, −0.583]	0.402 [0.186, 0.618]	0.432 [0.292, 0.571]	0.634 [0.479, 0.790]
DiscKnow	−0.988 [-1.183, −0.792]	−0.576 [-0.761, −0.392]	0.332 [0.184, 0.480]	0.317 [0.181, 0.452]	0.526 [0.374, 0.678]
NarrMotiv	−0.846 [-0.968, −0.723]	−0.128 [-0.257, 0.001]	0.454 [0.377, 0.531]	−0.454 [-0.542, −0.367]	0.424 [0.354, 0.495]
OpinMotiv	−0.842 [-0.952, −0.733]	−0.127 [-0.303, 0.049]	0.416 [0.351, 0.480]	−0.421 [-0.505, −0.337]	0.451 [0.374, 0.528]
InfoMotiv	−0.904 [-1.024, −0.784]	−0.136 [-0.281, 0.010]	0.432 [0.362, 0.501]	−0.428 [-0.496, −0.361]	0.442 [0.363, 0.521]
NarrPlan	−0.353 [-0.560, −0.146]	−0.507 [-0.667, −0.347]	−0.276 [-0.474, −0.078]	0.001 [-0.270, 0.272]	1.230 [1.069, 1.454]
OpinPlan	−0.448 [-0.654, −0.243]	−0.643 [-0.770, −0.515]	−0.280 [-0.455, −0.104]	0.022 [-0.291, 0.334]	1.442 [1.276, 1.608]
InfoPlan	−0.485 [-0.614, −0.356]	−0.509 [-0.663, −0.355]	−0.379 [-0.543, −0.215]	−0.045 [-0.305, 0.215]	1.470 [1.269, 1.671]

being included in Profile 2 and 2.4 times increased odds of being included in Profile 3 compared with fifth graders. Though the regression coefficients for Profiles 1 and 4 were not significant, the trends in ORs suggest fourth graders had increased odds of placement into Profiles 1 and 4 versus Profile 5. Overall, fifth graders had greater odds of being in the Globally Proficient group of writers than fourth graders.

Male students served as the reference category for gender. Based on the regression coefficients and related ORs, compared to boys, girls had significantly reduced odds of inclusion in Profiles 1 through 4 than Profile 5 by 79.0 % (OR = 0.210), 72.7 % (OR = 0.273), 66.4 % (OR = 0.336), and 78.7 % (OR = 0.213), respectively. Conversely, boys had an average of about 4 times (range of 2.98 to 4.76) increased odds of being included in Profiles 1 through 4 than girls. Thus, girls had greater odds of being classified as Globally Proficient than boys.

None of the regression coefficients were significant for White students (racial minority students served as the reference category), and the ORs for Profiles 1 through 4 versus 5 suggested these students had only slightly increased odds (on average, about 20 %) of being classified as Globally Proficient. Though none of the regression coefficients were significant for learners who spoke English as their native language (English learners served as the reference category), the trends in ORs suggested these students, compared with English learners, had decreased odds of being grouped into Profiles 1 and 2 versus Profile 5 but increased odds of being grouped into Profiles 3 and 4 versus Profile 5. Finally, for students without disabilities (students with disabilities served as the reference category), the slopes for Profiles 1, 2, and 3 versus 5 were significant. The associated ORs indicate students without disabilities, compared to students with disabilities, had reduced odds by 97.0 % (OR = 0.030), 90.6 % (OR = 0.094), and 73.3 % (OR = 0.267) of being categorized into Profiles 1, 2, or 3 rather than into Profile 5, respectively. Conversely, students with disabilities had 33.3 times increased odds of being included in Profile 1, 10.6 times increased odds of being included in Profile 2, and 3.75 times increased odds of being included in Profile 3 compared to students without disabilities (they also had 1.4 times greater odds of being grouped into Profile 4 versus Profile 5). Thus, students without disabilities were more likely to be classified as Globally Proficient writers.

3.3. *Writing quality differences predicted by latent profile membership*

Writing quality for narrative, opinion, and informative papers was regressed separately onto latent profile membership. Profile 5 (Globally Proficient writers), once again, served as the reference profile in these analyses. Because the auxiliary variables of grade, gender, and special education status significantly influenced profile membership, these were treated as covariates in each regression analysis; we also included race and English learner status as additional covariates to be conservative. The results, including bootstrapped (based on 1,000 bootstrapped samples) regression coefficients, standard errors, and 95 % CIs, are presented in Table 6. For narrative papers, except for Profile 4, the latent profiles were significantly inversely related to the average quality of papers written by students in Profile 5. The quality of narratives written by Globally Weak (Profile 1) and At-Risk (Profile 2) writers was about half a standard deviation lower on average than the quality of stories written by Globally Proficient (Profile 5) writers, while the quality of narratives written by Average Motivated (Profile 3) and Average Unmotivated (Profile 4) writers, in comparison to the quality of stories written by Globally Proficient writers, was about a tenth of a standard deviation lower on average. The differences in narrative quality between Profiles 1 and 2 and between Profiles 3 and 4 were not significant based on the largely overlapping confidence intervals (see Cumming, 2009), though the lowest performing writers did write lower quality papers than the average writers.

For opinion papers, all four latent profiles were significantly inversely related to the average quality of papers written by students who were classified as Globally Proficient. The quality of opinion essays

Table 5
Comparisons between latent profiles on demographic covariates.

	Latent Profile							
	Profile 1 vs 5		Profile 2 vs 5		Profile 3 vs 5		Profile 4 vs 5	
Covariate	β_0	β_1	β_0	β_1	β_0	β_1	β_0	β_1
Grade 5	0.534	−0.565	1.958**	−1.966**	0.867	−0.891**	0.518	−0.400
Female	1.549**	−1.555**	1.279**	−1.298**	1.060**	−1.090**	1.539**	−1.546**
White	0.282	−0.355	0.241	−0.220	−0.095	0.077	0.075	−0.141
Non-EL	1.093	−1.024	0.207	−0.277	−0.028	0.041	−0.309	0.291
No Disability	3.510**	−3.506**	2.311*	−2.353**	1.323	−1.320*	0.454	−0.343
	$\beta_0$odds	β_1OR[95 % CI]	$\beta_0$odds	β_1OR[95 % CI]	$\beta_0$odds	β_1OR[95 % CI]	$\beta_0$odds	β_1OR[95 % CI]
Grade 5	1.705	0.569 [0.175, 1.845]	7.087	0.141 [0.057, 0.349]	2.380	0.410 [0.179, 0.941]	1.678	0.671 [0.251, 1.793]
Female	4.708	0.210 [0.087, 0.510]	3.592	0.273 [0.138, 0.539]	2.887	0.336 [0.171, 0.658]	4.659	0.213 [0.108, 0.420]
White	1.326	0.701 [0.239, 2.054]	1.272	0.801 [0.279, 2.295]	0.909	1.082 [0.461, 2.543]	1.078	0.869 [0.387, 1.949]
Non-EL	2.983	0.358 [0.061, 2.117]	1.230	0.758 [0.156, 3.688]	0.973	1.042 [0.330, 3.296]	0.734	1.337 [0.344, 5.192]
No Disability	33.444	0.030 [0.005, 0.184]	10.084	0.094 [0.015, 0.615]	3.756	0.267 [0.037, 1.909]	1.575	0.710 [0.055, 9.240]

Note. β_0 = estimate of the intercept; β_1 = regression coefficient; OR = odds ratio; reference categories = grade 4, male, racial minority student, English learner (EL), student with disability.
** $p < 0.01$.
* $p < 0.05$.

written by Globally Weak and At-Risk writers was between 0.55 and 0.60 standard deviations lower on average than the quality of essays written by Globally Proficient writers, while the quality of opinion essays written by Average Motivated and Average Unmotivated, in comparison to the quality of those written by Globally Proficient writers, was about 0.22 to 0.30 standard deviations lower on average. The differences in opinion essay quality between Profiles 1 and 2 and between Profiles 3 and 4 were not significant based on the largely overlapping confidence intervals, but the lowest performing writers (Profiles 1 and 2) did perform significantly more poorly than the average writers (Profiles 3 and 4). The findings for informative paper quality are essentially the same, though papers written by the lowest performing writers were about a half standard deviation lower in quality on average in comparison with informative papers written by the best writers, while the average writers' quality of informative papers was about 0.15 standard deviations lower on average.

4. Discussion

While early cognitive models of writing (e.g., Flower & Hayes, 1981) portrayed writing as a complex activity that requires the orchestration of multiple components operating within three major processes (planning, translating, and reviewing), Hayes' 1996 revised model of writing added greater specificity to these processes (e.g., aspects of transcription) and expanded the components necessary for executing processes to include working memory capacity and affective stance, as these clearly influence performance of varied writing tasks (e.g., Deane et al., 2008; Hayes, 2011). The primary objective of our study was to capture the underlying distinct patterns or profiles displayed by upper elementary students based on observed measures aligned with Hayes' 1996 cognitive model. Our secondary goal was to explore the relationship between specific profiles and students' writing performance on three genre-based writing tasks. Furthermore, we also were interested in examining the effects of demographic variables on profile membership. Our findings

Table 6
Effects of profile membership on paper quality.

Narrative						
	Unstandardized B	Bootstrapped B	Standard Error (SE)	Bootstrapped SE	Bootstrapped 95 % CI	Standardized β
(Constant)	11.769**	11.813**	1.098	0.972	[10.234, 14.089]	
Globally Weak Writer	−6.035**	−6.031**	0.656	0.611	[-7.220, −4.844]	-0.467
At Risk Writer	−4.428**	−4.432**	0.536	0.530	[-5.431, −3.401]	-0.474
Average Motivated Writer	−1.300*	−1.285*	0.515	0.536	[-2.359, −0.298]	-0.137
Average Unmotivated Writer	−1.031	−1.000	0.586	0.589	[-2.243, 0.087]	-0.089
Opinion						
	Unstandardized B	Bootstrapped B	Standard Error (SE)	Bootstrapped SE	Bootstrapped 95% CI	Standardized β
(Constant)	12.617**	12.632**	1.092	1.034	[10.891, 14.535]	
Globally Weak Writer	−7.504**	−7.489**	0.663	0.669	[-8.831, −6.126]	-0.548
At Risk Writer	−5.913**	−5.926**	0.534	0.525	[-6.971, −4.893]	-0.601
Average Motivated Writer	−2.986**	−2.991**	0.514	0.541	[-4.053, −1.762]	-0.297
Average Unmotivated Writer	−2.586**	−2.626**	0.586	0.636	[-3.883, −1.402]	-0.215
Informative						
	Unstandardized B	Bootstrapped B	Standard Error (SE)	Bootstrapped SE	Bootstrapped 95% CI	Standardized β
(Constant)	12.955**	13.031**	1.202	1.198	[10.681, 15.477]	
Globally Weak Writer	−7.280**	−7.304**	0.732	0.651	[-8.486, −5.999]	-0.517
At Risk Writer	−5.342**	−5.362**	0.587	0.589	[-6.525, −4.194]	-0.531
Average Motivated Writer	−1.561**	−1.586**	0.567	0.694	[-2.802, −0.391]	-0.153
Average Unmotivated Writer	−2.045**	−2.023**	0.643	0.636	[-3.231, −0.827]	-0.162

** $p < 0.01$.
* $p < 0.05$.

offer validation of the components of Hayes' model in that we observed clear distinctions between elementary school-aged writers on clusters of variables associated with those components, namely cognitive processes involving text interpretation (i.e., word reading ability), production (i.e., handwriting and typing fluency, spelling, and punctuation aligned with transcription; vocabulary aligned with translation), and reflection (i.e., sophistication of pre-planning), writing-related knowledge, motivation for writing, and working memory.

4.1. Writer profiles of upper elementary students

Examining 335 fourth and fifth graders' performance on 15 writing-related measures, our results yielded five interpretable and relatively evenly distributed performance patterns. Consistent with the prior studies (e.g., Coker et al., 2018; Hooper et al., 2006; Roid, 1994; Wakely et al., 2006), we found that writing achievement in these grades is not a unitary construct but rather can be described by heterogeneous patterns that, of course, depend on the types of observed variables used to model the latent profiles, and that these patterns are generally predictive of actual writing performance. Diverse patterns in component writing skills, writing-related knowledge and motivation, and planning behaviors linked to actual task performance reinforce the claim that there are increasingly larger gaps between students in their writing achievement starting in third grade (e.g., Toste & Ciullo, 2017). These achievement gaps may exist because of the fundamental differences in students' component writing skills, differences that may be exacerbated due to the failure of a large proportion of students to develop sufficient basic writing skills (Graham & Harris, 2009), the general lack of individualization in instruction to address differences in components skills (e.g., Graham & Harris, 2013; Troia & Graham, 2017), and increased writing demands associated with the adoption of the Common Core State Standards (Costa et al., 2018).

We classified our sample of students into five subgroups using LPA: globally weak writers (Profile 1; $n = 41$), at-risk writers (Profile 2; $n = 91$), average motivated writers (Profile 3; $n = 85$), average unmotivated writers (Profile 4; $n = 51$), and globally proficient writers (Profile 5; $n = 67$). Globally weak writers and at-risk writers demonstrated below average performance on most observed writing variables as illustrated in Fig. 1, but the globally weak writers exhibited significantly weaker performance in spelling, word reading, vocabulary use in writing, working memory, writing knowledge, and writing motivation. At-risk writers, on the other hand, were nearly average with respect to their working memory and genre-specific motivation. Average motivated writers performed close to average or above average on all observed measures except for planning behaviors. As the group label suggests, these students were distinguished by their strong motivation to write (on par with the motivational characteristics of globally proficient writers). However, average motivated writers were relatively poorer at planning their compositions in the three genres compared to average unmotivated writers and globally proficient writers. Globally proficient writers typically had the best performance on all observed measures, with especially outstanding performance in planning for the genre-based writing tasks. Generally, the average motivated writers, average unmotivated writers, and globally proficient writers performed equivalently on component writing skills and knowledge assessments, but their scores for writing motivation and planning behaviors were quite different. In Table 7, we summarize this information for the reader using Hayes' (1996) model to categorize relative writing strengths and weaknesses for each profile.

Heterogeneous writing profiles have implications for educational practice in that they indicate the need for teachers and educational specialists to design and implement instructional practices and interventions that match the unique writing capabilities and needs of their students. Students in the globally proficient group who excelled on all tasks we employed likely would be considered responsive to instruction and thus simply require ongoing developmentally appropriate teaching

Table 7
Summary of writing profile attributes using Hayes' (1996) writing model.

Writing Profile	n	Relative Strengths	Overall Standard Deviation from Sample Mean	Relative Weaknesses	Overall Standard Deviation from Sample Mean
Globally Proficient	67	Text Interpretation (i.e., word reading) Text Production (i.e., transcription and translation) Reflection (i.e., planning) Working Memory Writing-related Knowledge Motivation for Writing	+0.42 +0.59 +1.38 +0.22 +0.58 +0.44	None	
Average Unmotivated	51	Text Interpretation Text Production Writing-related Knowledge	+0.50 +0.37 +0.37	Motivation for Writing	−0.43
Average Motivated	85	Text Interpretation Text Production Writing-related Knowledge Motivation for Writing	+0.28 +0.26 +0.37 +0.43	Reflection	−0.31
At Risk	91	None		Text Interpretation Text Production Reflection Writing-related Knowledge	−0.34 −0.53 −0.55 −0.66
Globally Weak	41	None		Text Interpretation Text Production Reflection Working Memory Writing-related Knowledge Motivation for Writing	−1.14 −0.88 −0.43 −0.73 −1.12 −0.86

to continue to make advances in (a) cognitive processes associated with writing (interpretation, reflection, and production) and (b) associated knowledge about writing. These students displayed adaptive motivation patterns across the major writing genres in terms of their self-efficacy beliefs, outcome expectations, and writing task interest and value judgments. Moreover, they devoted effort to planning their papers, regardless of genre, more so than any other group. This group exhibits an integrated array of well-developed skills, knowledge, and dispositions so important to writing success (Troia, 2006, 2011). Conversely, slightly more than 40 % of students in our study were classified as members of profiles 1 and 2, who demonstrated below-average performance on just about all writing-related measures we administered, suggesting that instruction tailored for these groups of children should focus primarily on boosting production skills associated with text transcription and the capacity to translate ideas into language using appropriate vocabulary (and grammar, even though this component skill was not evaluated in our study), as well as corresponding knowledge about writing mechanics and discourse. One would anticipate that, with improved skills and knowledge that would result from targeted instruction, these students would experience more writing success and consequently incrementally adjust their motivational dispositions toward writing and perhaps expend more effort planning their papers (e.g., Arrimada et al., 2019; Lassonde & Richards, 2013). The students in profiles 3 and 4 exhibited rather good production skills (i.e., transcription and translation), but their affective stance toward writing and their planning behaviors (which are reliant on the cognitive processes of interpretation and reflection) varied. Both groups likely would benefit from instruction aimed at increasing planning behaviors, such as writing strategy instruction (e.g., De La Paz, 1997; Glaser & Brunstein, 2007; Rodríguez-Málaga, 2021; Shen & Troia, 2018) and writing process instruction (e.g., Cutler & Graham, 2008; Graham & Sandmel, 2011; MacArthur et al., 1995; Troia & Olinghouse, 2013). The average but unmotivated writers also may profit from the addition of instructional scaffolds to support motivation to write, which may include self-regulatory activities such as setting proximal and distal goals for writing productivity, structure, and quality (e.g., Troia, 2002; see Troia, Shankland, & Wolbers, 2012 for review) and the use of digital writing tools (see Camacho et al., 2021; Ekholm et al., 2018 for reviews). It is important to note here that most students in our study either did not plan at all ahead of writing their papers on the computer or simply drafted a portion of text they intended to use in their papers on their planning sheet as evidenced by the grand mean of the planning scores for narrative, opinion, and informative papers in Table 1, an expected finding (e.g., Gillespie et al., 2013; Koutsoftas, 2018; Troia, 2006).

4.2. Effects of demographics on derived writer profiles

Examining the effects of sociodemographic factors on writing profile classification provides insight about influential non-cognitive factors in writing. It is well documented that student-level variables affect writing achievement (e.g., Caldas & Bankston, 1997; Graham et al., 2007; Olinghouse, 2008; Pajares & Valiante, 2001). Our results are in line with the extant literature, in that older students (i.e., fifth graders), girls, and students without confirmed disabilities possessed a significantly higher probability of being classified as globally proficient. For example, a meta-analysis conducted by Reilly, Neumann, and Andrews (2019) reported a medium effect (d = -0.42) of gender on writing proficiency, with girls outperforming boys. Similarly, Graham, Collins, and Rigby-Wills (2017) reported a large effect of −1.06 of disability status on writing quality, with typically-achieving students outperforming their peers with learning disabilities. Hence, in addition to considering the cognitive, linguistic, and affective aspects of writing, it also is important for educators to take sociocultural background into account when designing instruction and progressing through a curriculum. For instance, culturally responsive teaching practices—those that capitalize on (a) viewing individual differences as strengths, (b) differentiation of instruction and assessment to enhance accessibility and engagement, (c) fostering awareness of sociopolitical and cultural forces that often lead to personal and organizational biases, stereotypes, and institutionally-sanctioned marginalization, and (d) creating respectful and nurturing student-centered learning communities—can be implemented within writing instruction to value the importance of students' unique histories and prior experiences (Gay, 2018; Graham, 2019).

4.3. Writing quality differences among Writer profiles

Besides capturing a snapshot of upper elementary-aged students' writing skills, knowledge, and motivation, the present study also explores quality differences across genre-based writing tasks associated with latent profile membership. The regression results noted previously demonstrate that the three text types (narrative, informative, and opinion) produced by globally weak and at-risk writers were significantly lower in quality than those produced by globally proficient writers by 4.5–7.5 points out of 35 points possible. The texts produced by average motivated and unmotivated writers also were significantly (with an exception for narrative quality for average unmotivated writers) lower in quality than those written by globally proficient writers, but only by 1 to 3 points. These results were not surprising because the globally weak writers and at-risk writers underperformed on just about every writing-related measure, especially on tasks associated with basic writing skills involving transcription like handwriting, typing, spelling, and punctuation, which can greatly impact overall writing performance on composition tasks. This finding is consistent with many prior studies (e.g., Berninger et al., 1997; Christensen, 2005; Silverman et al., 2015), suggesting that low-level writing skills serve as both foundations of and risk factors for general writing performance. Olinghouse (2008) and others (e.g., Graham & Harris, 2009; Graham et al., 2012; Kent & Wanzek, 2016) have called for a balanced, comprehensive approach to writing instruction that addresses basic writing skills and higher-level composing skills and strategies.

4.4. Limitations and conclusions

Some important limitations exist in our study. First, due to the COVID-19 pandemic, longitudinal data from the third and fourth measurement points for the cohort of students in 2019–2020 were missing. Thus, their scores on the observed measures were calculated by averaging the first two data points, and thus these data may exhibit weaker stability and generalizability. Second, as written and oral language are intimately connected (e.g., Dockrell & Connelly, 2009; Kim & Schatschneider, 2017; Shanahan et al., 2006), we believe future research should incorporate measures of oral language into latent profile analyses so that more comprehensive insights about writers' traits can be extracted. It may be that quite different latent profiles would emerge if oral language competencies were included. Third, the fact that the five profiles we derived from our 15 writing-related, theoretically bound measures were associated with only three distinct levels of writing quality across the three genres we examined may suggest that our measure of quality (a genre-neutral dimensional rubric) was not sufficiently discriminating of students' writing performance. Perhaps other measures of writing performance such as linguistic metrics associated with written expression (e.g., sentence grammaticality, lexical complexity; e.g., Troia, Shen & Brandon, 2019) or more genre-oriented rubrics would produce more refined distinctions between writers. Conversely, it may be that the unique writer profiles we found in fact do not map neatly onto differing levels of writing performance. This remains an empirical question awaiting future research. Finally, though we accounted for the clustering of students within classrooms in our analyses for calculating robust standard errors and fit statistics, we did not determine if latent profiles emerged at the classroom level (see Marsh et al., 2012; Stapleton et al., 2016). For instance, classroom-level factors that might influence students' writing motivation could result in

more similar motivation patterns among students within a given subset of classrooms. Thus, teacher attributes (e.g., enthusiasm and supportiveness, see Kunter et al., 2013; Lei et al., 2018), classroom climate (e.g., focus on mastery learning, see Schiefele, 2017), and instructional practices (e.g., use of educational technology and informative feedback, see Williams & Beam, 2019; Wisniewski et al., 2020) that differ across classrooms and that are related to student motivation could create unique latent classroom profiles within which latent student profiles that include motivation variables are distributed. Research efforts to disaggregate child- versus classroom-level effects and profiles and to identify latent writing profile distributions across clusters through multilevel latent profile analysis would be highly desirable and appropriate.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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