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Mindful Acceptance Predicts Writing Achievement in 6th-Graders

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ABSTRACT

Writing is a complex task that requires the activation and coordination of several processes. In addition to the research on the domain-specific factors that contribute to school achievement, there is an increasing interest on general variables, such as mindfulness. Here, we aimed to test the contribution of middle-grade students' trait mindfulness to writing achievement, after controlling for well-known writing predictors. One hundred and eighty-seven 6th-graders ($M = 11.66$ years) were assessed on transcription, text quality, executive functions, and self-reported trait mindfulness. Preliminary analyses showed that our trait mindfulness measure had two factors: mindful awareness and acceptance. However, because only the latter was found to be reliable, main analyses were exclusively focused on the acceptance facet of mindfulness. A multiple hierarchical regression analysis was conducted. After controlling for demographic characteristics (Step 1), transcription skills (Step 2), and executive functions (Step 3), we examined the predictive role of mindful acceptance (Step 4) to writing achievement. Findings indicated that mindful acceptance had a significant contribution to writing achievement in Grade 6 ($b = .18$). These are pioneering findings about the contribution of mindful acceptance to writing. The putative mechanism underlying this contribution is discussed, and indications for future research are proposed.

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Executive functions; mindful acceptance; mindfulness; transcription; writing achievement

It is well established that writing is a complex and high-demanding task, requiring the activation and coordination of many processes. This is particularly evident in young writers, who are struggling to master those processes. The complexity of writing is well-captured in the Writer(s)-Within-Community model (WWC; Graham, 2018), which is one of the most recent and comprehensive models of writing. According to WWC, writing a text is shaped and constrained by the community in which the writer takes part (socio-cultural component) in articulation with writers' cognitive processes, including control mechanisms, long-term memory resources, modulators, and production processes (cognitive component). Two key cognitive processes in young writers are transcription (which includes the production processes of spelling and handwriting) and executive functions (which are subsumed under control mechanisms). From very early on, children need to acquire transcription skills to translate their ideas into text fluently and accurately, and to develop their executive functions to manage all the processes needed to produce coherent texts (Graham, 2018).

The key role of transcription and executive functions in children's writing is supported by other theoretical models (Berninger & Chanquoy, 2012; Berninger & Winn, 2006) and empirical findings (Cordeiro et al., 2020; Salas & Silvente, 2020). However, writing achievement is not fully explained by these two processes. As proposed in the WWC model (Graham, 2018), there are other variables that can influence text quality in young writers. Whereas some of these variables have received extensive research attention, such as self-efficacy (Limpo & Alves, 2017), others have been less researched, such

as mindfulness (Caballero et al., 2019). Mindfulness combines attentional and attitudinal factors related to individuals' immediate experience (Bishop et al., 2004). In a demanding and difficult task such as writing, the enhanced focus and positive attitudes intrinsic to mindfulness may support the enactment of cognitive processes and help young writers to produce better texts.

In the present study, we intended to explore the role of mindfulness on writing achievement in young writers. Given the key role that demographic variables (Cordeiro et al., 2018; Midgette et al., 2008), transcription skills (Limpo & Alves, 2013; Limpo et al., 2017), and executive functions (Cordeiro et al., 2020; Drijbooms et al., 2015) play in writing, we conducted a stringent test of the link between mindfulness and writing achievement in Grade 6, after controlling for these well-known predictors.

Cognitive processes involved in writing

Among the many cognitive models that describe the multitude of processes involved in writing, the WWC model (Graham, 2018) was used to guide the present study due to its recency and comprehensiveness as well as openness to include less-researched processes, such as mindfulness. As described above, the WWC proposes that writing influences and is influenced by the community where it takes place as well as by writers' cognitive processes. Among these, transcription and executive functions are particularly relevant in children's writing.

Transcription is the externalization of language in the form of written text, which involves the retrieval, assembling, and selection of orthographic symbols (i.e., spelling); and the execution of motor movements required by a particular writing tool to produce those symbols (i.e., handwriting/typing; Abbott & Berninger, 1993). Handwriting and spelling have been found to be related to writing performance in primary and middle grades (Graham et al., 1997; Limpo & Alves, 2013; Olive et al., 2009). Recent evidence suggests that, even in middle-grade students (12–15 years), transcription skills seem to constrain text quality indirectly, by influencing high-level production processes, such as ideation or translation (Limpo et al., 2017).

Executive functioning involves top-down mental processes that coordinate cognitive, behavioral, and emotional functions, thereby enabling individuals to successfully engage in purposeful and self-directed behavior (Lezak et al., 2012). A helpful conceptualization to understand executive functions in children was proposed by Diamond (2013). According to this, there are three core executive functions: inhibitory control, including selective attention (control of behavior, thoughts, and emotions while ignoring irrelevant stimuli); working memory (holding and manipulation of information in mind); and cognitive flexibility (adjustment of perspectives to new requirements). These functions set the basis for other higher-order functions (Diamond, 2013; Lunt et al., 2012): reasoning (inference of patterns or relations among items) and planning (implementation and monitoring of strategies to achieve goals). This conceptualization of executive functions is aligned with the control mechanisms identified in the WWC model (Graham, 2021), which are fundamental for good writing. Prior studies showed that inhibition, working memory, and flexibility, as well as planning, were related to children's writing performance (Altemeier et al., 2008; Cordeiro et al., 2020; Drijbooms et al., 2015, 2017).

Despite the well-established importance of transcription and executive functions for young writers' performance, the percentage of variance in writing achievement explained by these processes tend to be below 50% (e.g., Cordeiro et al., 2020; Kim, 2020; Kim & Park, 2019; Salas & Silvente, 2020). This means that, though important, transcription and executive functions are not enough to explain individual differences in writing. This is acknowledged in the WWC model (Graham, 2018), which proposes that other physical and psychological factors (called modulators) may influence writing performance, such as emotions, personality traits, and physiological states. Based on recent work showing that mindfulness is related to academic achievement (Dunning et al., 2019; Maynard et al., 2017; Schonert-Reichl & Roeser, 2016), as well as literacy-related variables (Bakosh et al., 2015;

Cordeiro et al., 2021), we propose that mindfulness can be one of those modulators and play a key role in children's writing, above and beyond transcription and executive functions.

Mindfulness and academic achievement

Mindfulness can be defined as an enhanced focus on the present moment with nonjudgmental and acceptance attitudes toward the immediate experience (Bishop et al., 2004; Hooker & Fodor, 2008; Kabat-Zinn, 2003). Typically, mindful individuals can concentrate during long periods, ignore inner and outer distractions, and shift between narrow and diffuse attention styles, without comparing, categorizing, or evaluating the observed stimuli or phenomena (Brown et al., 2007). Clearly, there is a connection between mindfulness and other cognitive processes, including executive functions (Maynard et al., 2017). Still, child studies showed that they are fairly independent, with low-to-moderate correlations, ranging between $-.27$ and $.49$ (Geronimi et al., 2020; Riggs et al., 2014).

Although the above-provided definition is the most used conceptualization of mindfulness, it was derived from studies conducted with adults. To the best of our knowledge, there is not enough research conducted with children for a definition specifically targeting them to be available in the field. Nonetheless, from an applied perspective, there are clear differences between children and adults in regard to mindfulness. These differences are reflected in the development of age-appropriate instruments to measure mindfulness (Goodman et al., 2017). Typically, these instruments are self-report measures of state or trait mindfulness. Whereas state mindfulness refers to the ability to cultivate a particular state of mind, experienced by meditators during practice or non-meditators in daily life (Brown & Ryan, 2004), trait mindfulness refers to the individuals' predisposition to be mindful in their daily life (Baer et al., 2006; Kiken et al., 2015). Mindfulness as a trait is a stable or dispositional quality, which serves as basis for the development of state mindfulness (Lawlor et al., 2013; Quaglia et al., 2016). Given the exploratory and assessment characteristics of our study, we considered and assessed mindfulness as a trait.

Trait mindfulness can be measured through instruments of self-report grounded on uni or multidimensional definitions of mindfulness (Bergomi et al., 2013). In general, all definitions conceptualize mindfulness as involving an awareness and an acceptance dimension. However, whereas unidimensional approaches argue that these dimensions cannot be separated (e.g., Brown & Ryan, 2004), multidimensional approaches tend to decompose them into specific facets (e.g., observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience; Baer et al., 2006). Given the exploratory nature of the present study along with the availability of validated instruments in Portuguese, the design of this study was grounded on a unidimensional definition of mindfulness. Indeed, to the best of our knowledge, to date, there is only one Portuguese mindfulness measure for children, the Child and Adolescent Mindfulness Measure (CAMM; original version from Greco et al., 2011; adapted version from Cunha et al., 2013).

Though the link between trait mindfulness and writing has never been tested, there is accumulating evidence showing that children's mindfulness is associated with academic achievement (Maynard et al., 2017; Schonert-Reichl & Roeser, 2016; Shapiro et al., 2015). In a study with 2,000 students in Grades 5–8, self-reported trait mindfulness predicted performance in grade point average and standardized tests of mathematics and literacy (Caballero et al., 2019). Complementing these correlational findings, experimental research showed that mindfulness training improved Portuguese scores in Grade 3 (Cordeiro et al., 2021), science and reading scores in Grade 3 (Bakosh et al., 2015), and math scores in Grades 4–5 (Schonert-Reichl et al., 2015).

As suggested by Lyons and DeLange (2016), trait mindfulness seems to be related to academic achievement because of its association with cognitive abilities, such as executive functions, including attention (Hooker & Fodor, 2008; Napoli et al., 2005; Raffone & Srinivasan, 2016; Takacs & Kassai, 2019), as well as emotion-related abilities, such as emotion regulation (Grossman et al., 2004; Tang & Posner, 2009). Given the importance of these cognitive and emotion-related abilities in writing,

acknowledged in the WWC model (Graham, 2018), we proposed that mindfulness could be uniquely related to achievement in writing.

Composing a text is highly complex from cognitive and social viewpoints. Writing requires the enactment of several and effortful cognitive processes that must be successfully juggled during text production (Olive, 2014). The enhanced focus present in individuals with high levels of trait mindfulness may facilitate the management of these processes. Trait mindfulness may be important to produce good texts, by allowing writers to focus on the writing task and ignore distractors (e.g., anxiety-related thoughts and feelings), as well as by bringing the mind back to the task after accepting it can wander. From a social viewpoint, the increasingly strict demands and social perfectionism imposed by schools put high pressure on students concerning what is expected from them and what they should do to succeed (Short & Mazmanian, 2013). Consequently, many students may experience negative feelings and thoughts, leading to difficulties in composing, which can have a detrimental effect on performance. A potentially helpful factor for mitigating the harmful nature of these feelings and thoughts is mindfulness (Mrazek et al., 2013, 2017).

Present study

Writing is a demanding task that involves a multitude of processes that need to be coordinated to produce high-quality texts. Transcription and executive functions are particularly important processes in children's writing. Nonetheless, they do not seem enough to explain individual differences in writing achievement, leaving room for other processes that may play a relevant role in writing, such as mindfulness. Grounded on this line of reasoning, the present research aimed to test the unique contribution of trait mindfulness to writing achievement in Grade 6, after controlling for demographics, transcription, and executive functions. Our main hypotheses are presented below.

We expected that demographics, transcription, and executive functions would predict writing performance, based on the prior evidence. On the one hand, demographic variables, such as gender and socioeconomic status, represent a source of differences in writing performance. Male students (Cordeiro et al., 2018; Midgett et al., 2008) and students from low socioeconomic status (Kim et al., 2015; Mo & Troia, 2017) seem to be at a great disadvantage. On the other hand, as surveyed above, it is well-established that transcription (e.g., Limpo & Alves, 2013) and executive functions (e.g., Drijbooms et al., 2017) have a significant contribution to writing performance in primary and middle grades.

Additionally, we anticipated that trait mindfulness would explain additional variance in writing performance. Despite being the first study testing this mindfulness-writing link, this hypothesis relies on past findings suggesting that mindfulness is positively associated with achievement in literacy-related domains (Cordeiro et al., 2021; Maynard et al., 2017) and that writing requires the control and management of cognitive and emotional processes (Graham, 2018), which are key mindfulness components.

Method

Participants and setting

Participants were 187 typically developing Portuguese-native speakers in Grade 6 ($M = 11.66$ years, $SD = 0.44$; 104 girls) from 10 classes in two different schools. The educational level of students' mothers, which was used as a proxy to students' socioeconomic level, was assessed in five ordered levels, corresponding to the completion of Grade 4 (level 1), Grade 9 (level 2), high school (level 3), college (level 4), and any post-graduation course (level 5). The distribution of the educational level of students' mothers was as follows: 4% for level 1, 39% for level 2, 25% for level 3, 25% for level 4, and 7% for level 5 (information provided by the schools). The study was approved by the ethics committee of the authors' university.

Instruments

Transcription measures

Handwriting fluency. Children were given 90 seconds to copy a sentence with all letters of the alphabet, as quickly and legibly as possible. The final score was the number of words copied. Higher scores indicate a higher ability to write words fluently.

Spelling. Children performed a dictation task composed of 16 words that represent some of the complexities of the Portuguese spelling system (e.g., stress marks, silent letters, consonantal clusters, inconsistencies; Magalhães et al., 2020). The final score was the number of misspelled words. Lower scores indicate a higher ability to spell words correctly.

The first author, who has a large amount of experience in evaluating handwriting and spelling skills, coded all the tasks. To ensure coding reliability, she trained a second judge, who rescored 40% of each task. Inter-rater reliability was measured with the intraclass correlation coefficient (ICC) for consistency estimates for single rater, based on a two-way mixed effects model. ICC was high for both tasks (.98 for handwriting fluency and .99 for spelling).

Executive functions measures

Reasoning. We used *Raven's Colored Progressive Matrices* (Raven et al., 2004; Simões, 2000), which is a test that includes three sets of 12 items. In each item, children were asked to identify the missing element of a pattern among six options. The final score was the sum of correct answers. Higher scores indicate better ability to infer patterns and relationships between items. This task has a good internal consistency ($.65 < \alpha < .88$; Simões, 2000).

Attention. We used the *Cancellation Task* from the Coimbra Neuropsychological Assessment Battery (BANC), which lasts for 10 minutes (Simões et al., 2016). Children were given a sheet with squares organized in lines and were asked to cross out the squares that matched a previously presented model. The final score resulted from a formula that considers the squares correctly crossed, omitted, and incorrectly crossed. Higher scores indicate higher ability to focus and ignore irrelevant information. This task has good stability coefficient measured through test-retest ($r = .61$) and acceptable validity evidence ($.24 < r < .58$; Simões et al., 2016).

Working memory. We assessed verbal and non-verbal working memory through the *Backward-Digit Span Task* from the Wechsler Intelligence Scale for Children-III (Simões et al., 2003) and the *Corsi Blocks* from the BANC (Simões et al., 2016), respectively. In these tasks, children were asked to recall sequences of numbers or blocks with increasing length in backward order. The final scores were the number of sequences correctly recalled. Higher scores indicate higher ability to hold and manipulate information in mind. The *Backward-Digit Span Task* has a good stability coefficient ($r = .80$; Simões et al., 2003) and the *Corsi Blocks* also has good of stability coefficient through test-retest ($r = .61$) and validity ($.38 < r < .64$; Simões et al., 2016).

Inhibitory control. We used the inhibition score of the *Inhibition Subtest* of the NEPSY-II, A Development Neuropsychological Assessment (Korkman et al., 2007). Participants were given a sheet depicting black and white shapes (Part I) or arrows (Part II) and were asked to say the opposite form (i.e., saying square when circle and vice versa) or arrow direction (i.e., saying up when pointing down and vice versa). The final score is the total time of completion (maximum 240 second), with shorter times indicating higher ability to ignore irrelevant stimuli. This task has good test-retest reliability ($r = .81$, Brooks et al., 2009) and excellent internal consistency ($\alpha = .92$; Korkman et al., 2007). In this study, internal consistency considering Part I and II was acceptable ($\alpha = .56$).

Cognitive flexibility. We used the flexibility score of the *Inhibition Subtest* of the NEPSY-II (Korkman et al., 2007). Despite being provided with the same sheet of black/white shapes/arrows described above, in this task, children were asked to consider the color of the shape or arrow. They had to say the correct shape or arrow direction if it was colored black, or to say the opposite shape or arrow direction if it was colored white. The final score is the total time of completion (maximum 240 seconds), with shorter times indicating higher ability to adapt to new requirements. This task has good test-retest reliability ($r = .82$, Brooks et al., 2009) and excellent internal consistency ($\alpha = .99$; Korkman et al., 2007). In this study, internal consistency considering Part I and II was acceptable ($\alpha = .71$).

Planning. We used the *Tower Task* from the BANC (Simões et al., 2016), which includes a tray with three pins with different heights and three colorful balls. Children were asked to copy increasingly complex models presented on cards. The final score was the number of models correctly completed at the first trial. Higher scores are indicative of higher ability to implement and monitor strategies to achieve goals. This task has a moderate stability coefficient assessed through test-retest ($r = .33$; Simões et al., 2016).

Mindfulness questionnaire. To assess students' trait mindfulness, we used the Child and Adolescent Mindfulness Measure – CAMM (Greco et al., 2011), validated to Portuguese by Cunha et al. (2013). Currently, this is the only measure of trait mindfulness available for Portuguese-speaking children. Both versions of the CAMM have adequate indexes of validity and reliability ($\alpha = .81$ for original version, and $\alpha = .80$ for the Portuguese version). This instrument is composed of 10 items that load on a single factor, even though it includes items related to the two main mindfulness components, namely, awareness (e.g., *At school, I walk from class to class without noticing what I'm doing*) and acceptance (e.g., *I tell myself that I shouldn't feel the way I'm feeling*). Indeed, in other languages, a two-factor structure was identified (De Bruin et al., 2014). Due to these mixed findings, and because the Portuguese version was validated with adolescents with an average age of 15 years, we conducted a preliminary study to check the validity and reliability of the scale to 11–12-year-olds, including the adequacy of its factorial structure.

CAMM validity and reliability – preliminary study. In this study, 140 sixth-graders not involved in the main study (age 11–12) were asked to fill in the 10-item CAMM. To determine the factor structure of the scale, we conducted an Exploratory Factor Analysis (EFA) with Varimax rotation, and the following stringent criteria were used to remove items based on each EFA results: (a) communalities below .45, (b) cross-loadings above .40, and (c) factors with less than three items (based on Brown, 2006; Tabachnick & Fidell, 2007). The first EFA ($KMO = .80$; Bartlett's Test of Sphericity, $p < .001$), which revealed a three-factor structure explaining 61% of the variance, showed that all communalities were above .45. However, item 7 loaded on two factors with loadings of .52 and .45, and item 5 and item 10 formed a single factor. Based on the previously defined criteria, these items were removed. The remaining seven items were subject to a second EFA that showed communalities above .48. The analysis revealed two factors explaining 60% of the total variance. One factor included items 1, 4, 8, and 9, with factor loadings of .80, .71, .73, and .77, respectively; the other factor included items 2, 3, and 6, with factor loadings of .82, .66, and .67, respectively.

After an examination of items content, the first factor was labeled “mindful acceptance” and the second factor was labeled “mindful awareness” (cf. Bishop et al., 2004). Internal consistency, measured with the ordinal omega, was acceptable for both factors ($\omega = .83$ for mindful acceptance, and $\omega = .66$ for mindful awareness). This 7-item scale was used in the main study.

CAMM validity and reliability – main study. The 7-item scale was administered to the participants of the main study ($N = 187$). Confirmatory factor analyses (CFA) were conducted to examine the 2-factor structure of the instrument. Latent variables were scaled by imposing unit of loading identification constraints. Specifically, the variance of both latent factors was constrained to equal 1.0. To evaluate

model fit, we used the chi-square statistic (χ^2), the confirmatory fit index (CFI), and the root-mean-square error of approximation (RMSEA). CFI values $> .95$ and RMSEA values $< .06$ are considered good fits (Hu & Bentler, 1999). Results revealed a very good model fit, $\chi^2 (13, N = 187) = 6.65, p = .96$, CFI = 1.00, RMSEA = 0, $P(\text{rmsea} \leq .05) = .99$, with factor loadings ranging from .69 to .80 in the mindful acceptance factor, and from .41 and .46 in the mindful awareness factor (all $ps < .001$). An examination of the ordinal omega for both factors showed a very good internal consistence for acceptance ($\omega = .86$), but an unacceptable result for awareness ($\omega = .46$). We therefore decided to remove the awareness factor and conduct a new CFA with the acceptance factor only. We found an excellent model fit, $\chi^2 (2, N = 187) = 2.33, p = .31$, CFI = .99, RMSEA = .03, $P(\text{rmsea} \leq .05) = .46$, with good factor loadings ($> .68$). Given these results, only the 4-item mindful acceptance factor was used in the subsequent analyses.

Writing achievement. Two research assistants, blind to study purposes, assessed the quality of children's opinion essays with a holistic scale based on Cooper (1977). Both judges were asked to evaluate each text with a single score ranging from 1 (*low quality*) to 7 (*high quality*). This score should consider to the same extent the following factors: creativity, coherence, syntax, and vocabulary. To avoid transcription biases on quality assessments, all texts were typed and corrected for misspellings (Berninger & Swanson, 1994). The validity of this procedure to assess text quality across different genres and grade levels is well documented (e.g., Harris et al., 2006; Limpo & Alves, 2018).

Before assessing students' opinion essays, judges participated in an 8-hour workshop, where the last author, who has a vast experience in scoring writing achievement and training other judges, explained the four above-mentioned factors; presented anchor texts representing low-, middle-, and high-quality scores; and discussed the distinctive features of anchor points. Then, judges practiced applying the scale collaboratively under the trainer's guidance. When the coding procedure was fully understood, judges rated a set of texts independently. Scores were then compared and when disagreements appeared, they were resolved through discussion. After achieving full agreement, judges started rating students' opinion essays. The inter-judge agreement was high, as indicated by the ICC for consistency estimates for the average across two raters, based on a two-way mixed effects model: .91 for Text 1 and .92 Text 2. Given that, the final score for this task was the average of both texts across judges.

Procedure

During the second term of the Portuguese academic year (January-February), all students were evaluated in two 40-minute individual testing sessions plus two 25-minute class testing sessions. After all students completed the first individual session, we conducted the class sessions. These latter took place in the same week, with a minimum of two days of interval. In the following weeks, we conducted the second individual session, which occurred 2 to 3 weeks after the first one. The individual sessions were conducted in a quiet room by highly trained research assistants with a graduate degree in psychology. Students performed the *Raven's Colored Progressive Matrices*, *Backward-Digit Span Task*, *Corsi Blocks*, and *Inhibition* tasks in one session; and the *Tower* and *Canceling* tasks in another session. Sessions order was counterbalanced.

The class sessions were conducted with the whole classroom (ca. 20 students) by the same research assistants. At the beginning of each session, students were asked to write by hand an opinion essay for 10 minutes. This duration was chosen because prior research showed that 6th-graders spent between 8 and 11 minutes on unlimited writing tasks (Torrance et al., 2007). Moreover, there is evidence that periods between 5 and 10 minutes are enough for students to produce a complete piece of writing with sufficient information for quality assessments (Espin et al., 2000; Limpo & Alves, 2013). The 10 minutes were used to produce a single draft. We did not explicitly ask them to revise their text and produce a final product, as this would increase task demands with likely little benefit. Indeed, novice writers' revising behavior is very limited, more focused on mechanical than substantive errors, and with reduced impact on text quality (for a discussion on this, see Limpo & Alves, 2014). Opinion essays

were chosen because though 6th-graders are expected to defend a reasoned opinion and to know how to share it in writing (Direção Geral da Educação, 2018), it is still a demanding task that may call for several key writing processes (Berman & Nir-Sagiv, 2007). The prompts were: “*Do you think teachers should give students homework every day?*” (Session 1) and “*Do you think it is good to have many brothers/sisters?*” (Session 2). Both prompts were judged by middle-grade teachers as appropriate to students’ age. After writing the text, students did the copy task in Session 1 and filled in the CAMM and did the spelling task in Session 2. Other questionnaires were administered at the end of both sessions.

However, these are not relevant for the present study, and thus not further considered.

Data analytic strategy

All analyses were conducted using IBM SPSS Statistics (Version 26). For inferential statistics, a level of significance of .05 was used. Before conducting the analyses, we inspected all variables distribution to determine the appropriateness of using parametric procedures. Skewness and kurtosis values were below |3| and |10|, respectively, suggesting no severe deviations from the normal distribution (Kline, 2005). Then, we examined the descriptive statistics for all variables along with the zero-order correlations between them. In order to do a stringent test of the contribution of mindfulness acceptance to writing achievement in Grade 6, we conducted a multiple hierarchical regression analysis with four steps. On Step 1, we entered gender and socioeconomic status as control variables. Gender was introduced as a dummy variable (0 = boy, 1 = girl), and socioeconomic status was considered as an ordinal variable with five levels, with higher values indicating higher socioeconomic status. On Step 2, we entered the two transcription variables (handwriting fluency and spelling). On Step 3, we entered all executive functions variables (reasoning, attention, verbal working memory, non-verbal working memory, inhibitory control, cognitive flexibility, and planning). Finally, on Step 4, we entered mindful acceptance. This stepwise procedure allowed us to test the unique contribution of mindful acceptance to writing achievement, above and beyond demographics, transcription, and executive functions.

Results

Descriptive statistics and preliminary analysis

Table 1 presents the descriptive statistics for all variables along with the correlations between them. Concerning transcription variables, students copied an average of 32 words in 90 seconds and produced an average of 5 errors out of 16 (34% of misspelled words). As expected, handwriting and spelling were moderately correlated with each other ($r = -.21$). In regard to executive functions, students achieved 31 points in the Raven and a score of 14 in the attention task. As for working memory, they were able to recall 5 and 6 items in the verbal and non-verbal tasks, respectively. On average, the inhibition and flexibility tasks were finished in 65 seconds and 105 seconds, respectively. In the planning task, students were able to correctly complete a total of 10 models at the first trial. Excepting verbal working memory and cognitive flexibility, all measures of executive functions were correlated among each other ($.14 < |rs| < .41$). Spelling was correlated with all executive functions ($.17 < |rs| < .32$), but handwriting was only correlated with working memory, inhibition, and cognitive flexibility ($.17 < |rs| < .26$). Regarding mindful acceptance, students achieved an average score of 3 (ranging from 1 to 5, with higher scores indicating higher mindful acceptance traits). This variable was found to be related only with gender ($r = -.21$) and inhibitory control ($r = -.19$). Finally, the 6th-graders reached an average score of 4 out of 7 in the writing achievement measure. With the exception of non-verbal working memory and mindful acceptance, students’ writing achievement was found to be associated with all other variables ($.17 < |rs| < .35$).

Table 1. Descriptive statistics for and bivariate correlations between all measures.

Variables	Descriptive statistics		Bivariate correlations											
	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender (0 = boy, 1 = girl)	0.56	0.50												
2. Socioeconomic status	2.92	1.05	.06											
3. Handwriting fluency	32.31	6.56	-.14*	.16*										
4. Spelling	5.39	2.22	-.10	-.37***	-.21**									
5. Reasoning	31.33	3.48	-.04	.25***	.09	-.20**								
6. Attention	13.82	4.10	-.02	.08	.05	-.17*	.30***							
7. Verbal working memory	5.11	1.54	.01	.15*	.17**	-.32***	.28***	.14*						
8. Non-verbal working memory	6.15	2.08	.01	.18**	.12*	-.21**	.43***	.35***	.27***					
9. Inhibitory control	64.78	16.09	-.03	-.28***	-.16*	.26***	-.41***	-.36***	-.17*	-.29***				
10. Cognitive flexibility	104.71	33.30	.15*	-.20**	-.26***	.19**	-.30***	-.33***	-.12	-.23***	.57***			
11. Planning	10.01	1.81	.03	.24***	.09	-.25***	.26***	.20**	.17*	.17**	-.22**	-.15*		
12. Mindful acceptance	2.91	1.12	-.21**	-.04	-.04	.01	-.06	.02	-.04	-.08	.19**	.10	-.08	
13. Writing achievement	3.86	0.84	.29***	.33***	.24***	-.35***	.26***	.28***	.17**	.12	-.24***	-.19**	.18**	.09

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. Coefficients of the final regression model (step 4) predicting writing achievement ($R^2 = .38$).

	B	SE	b	t	p
Gender (0 = boy, 1 = girl)	0.60	0.11	.36	5.61	<.001
Socioeconomic status	0.15	0.05	.19	2.80	.01
Handwriting	0.03	0.01	.21	3.28	.001
Spelling	−0.05	0.03	−.14	−2.04	.04
Reasoning	0.04	0.02	.15	2.10	.04
Attention	0.04	0.01	.21	3.07	.002
Verbal working memory	0.01	0.04	.02	0.32	.75
Non-verbal working memory	−0.05	0.03	−.12	−1.71	.09
Inhibitory control	0.00	0.00	.01	0.14	.89
Cognitive flexibility	0.00	0.00	−.06	−0.75	.45
Planning	0.00	0.03	.01	0.16	.87
Mindful acceptance	0.14	0.05	.18	2.94	.004

Multiple hierarchical regression analysis

An examination of the correlation matrix showed no signs of multicollinearity ($-.41 < |rs| < .57$); all predictors were included in the model as initially planned. Coefficients of the final model with all predictors are detailed in Table 2.

On Step 1, the two variables were found to explain 19% of the variance in writing achievement, $R = .43$, $F(2, 184) = 21.04$, $p < .001$. Both gender ($b = .27$, $p < .001$) and socioeconomic status ($b = .32$, $p < .001$) were found to be significant predictors.

On Step 2, results showed that transcription skills explained an additional 9% of the variance in writing achievement, $R = .52$, $F(4, 182) = 17.02$, $p < .001$. This increase in the amount of variance explained was statistically significant, $F_{change}(2, 182) = 10.76$, $p < .001$. Besides gender ($b = .29$, $p < .001$) and socioeconomic status ($b = .21$, $p = .002$), both handwriting ($b = .21$, $p = .002$) and spelling ($b = -.20$, $p = .01$) had a unique and significant contribution to writing achievement.

On Step 3, executive functions explained 8% of the variance in writing achievement, above and beyond the other variables, $R = .59$, $F(11, 175) = 8.57$, $p < .001$. This additional amount of variance explained achieved statistical significance, $F_{change}(7, 175) = 10.76$, $p = .005$. Gender ($b = .32$, $p < .001$), socioeconomic status ($b = .19$, $p = .01$), handwriting ($b = .20$, $p = .002$), and spelling ($b = -.16$, $p = .03$) continued to be significant predictors. Moreover, reasoning ($b = .16$, $p = .04$) and attention ($b = .23$, $p = .001$) were also found to be unique contributors of writing achievement.

Finally, on Step 4, results showed that there was an increase of 3% in the amount of variance explained, after controlling for demographics, transcription, and executive functions, $R = .62$, $F_{change}(1, 174) = 8.64$, $p < .004$. The full model explained a total of 38% of the variance in writing achievement, $F(12, 174) = 8.92$, $p < .001$. Above and beyond gender ($b = .36$, $p < .001$), socioeconomic status ($b = .19$, $p = .01$), handwriting ($b = .21$, $p = .001$), spelling ($b = -.14$, $p = .04$), reasoning ($b = .15$, $p = .04$), and attention ($b = .21$, $p = .002$), we found that mindful acceptance ($b = .18$, $p = .004$) had a significant and unique contribution to writing achievement.

Discussion

This study provided a stringent test of the predictive role of trait mindful acceptance on writing achievement by examining this link after controlling for key writing variables. Findings indicated that mindful acceptance had a significant and unique contribution to writing achievement in Grade 6, above and beyond control predictors.

Predictive role of demographics, transcription, and executive functions

In line with our hypotheses, the regression analysis showed that demographic characteristics and transcription skills were associated with writing achievement. We found that girls displayed better

performance than boys, agreeing with past findings (Cordeiro et al., 2018; Midgette et al., 2008). We also found that students with more educated mothers showed higher writing achievement. A similar relationship was also found in prior research (Kim et al., 2015).

Transcription was also a significant predictor of writing achievement. Students that copied more words and produced fewer misspellings produced better texts. These findings join past research showing that, even after primary grades, composing good texts relies on the production of fast handwriting and correct spellings (Alves & Limpo, 2015; Limpo & Alves, 2013; Limpo et al., 2017).

Supporting prior research (e.g., Cordeiro et al., 2020; Drijbooms et al., 2015), we observed a significant contribution of executive functions to writing achievement. However, a closer look into these findings revealed differences between studies. Significant writing predictors in this study were reasoning and attention. However, significant predictors in past studies were working memory and planning (Cordeiro et al., 2020), or inhibition and working memory (Drijbooms et al., 2015). These mixed findings are likely explained by methodological differences among studies (e.g., grades studied, measures used, and research design). Additionally, it should be noted that these studies typically include a different set of predictors in the models under test, which may influence the results. In the present study, the regression analysis showed that the majority of executive functions targeted were not significant predictors of writing achievement. However, the bivariate correlations showed a different pattern. Indeed, excepting non-verbal working memory, all other executive functions were significantly correlated with writing achievement ($.18 < r < .28$). Thus, more than putting into question the link between executive functions and writing achievement anticipated by the WWC model (Graham, 2018), this study highlights the importance of determining the methodological circumstances affecting this link. In spite of the evidence on an overall link between executive functions and writing (St Clair-Thompson & Gathercole, 2006; Limpo & Olive, 2021; Olive, 2014), the mixed findings in the field signal the need for more research to unravel the specific executive components that influence writing at different developmental stages.

Together, these findings support the WWC model (Graham, 2018), highlighting the importance of transcription and executive functions in text production. However, as shown here, with an amount of 35% of explained variance, these processes may not suffice to explain achievement in writing.

Predictive role of mindful acceptance

A major and pioneering finding of this study was that mindful acceptance had a unique and independent contribution to writing achievement, above and beyond the predictive role of demographics, transcription, and executive functions. Specifically, we found that higher levels of mindful acceptance were associated with the production of better texts. From a mindfulness-based viewpoint, mindful acceptance means acknowledging the presence of intrusive thoughts/feelings and allowing them to pass over without judging and adhering to them (Bishop et al., 2004). This non-judgmental acceptance attitude of individuals' own experiences is one of the main characteristics of mindfulness (Bishop et al., 2004; Kabat-Zinn, 2003; Kropp & Sedlmeier, 2019). A key question arising from current findings is therefore: How is mindful acceptance related to writing performance? Though our study does not provide an empirical response to this question, we propose that students with higher levels of mindful acceptance may be less influenced by negative feelings and thoughts during writing, which in turn may be associated with better performance. This may come from the fact that negative feelings reduce working memory capacity by automatically activating intrusive thoughts (Brewin & Smart, 2005; Ellis & Moore, 1999; Klein & Boals, 2001). Children with higher mindful acceptance may be less prone to intrusive thoughts and may have more cognitive resources at their disposal. The role of emotions, and how they affect task engagement, was already acknowledged in the WWC model (Graham, 2018). The present findings may extend this model by proposing that there is another variable (i.e., mindful acceptance) that allows writers to deal with the thoughts and emotions that appear during text production and may interfere with writing achievement.

Rather than eliminating negative feelings and thoughts associated with writing, a mindful acceptance attitude may reduce the extent to which unwanted feelings and thoughts interfere with task performance. By involving a non-judgmental and non-adhering approach to feelings and thoughts, an attitude of mindful acceptance may enable individuals to regain control over the task and experience an increase in attentional focus. This enhanced concentration, coupled with positive affect and adaptative mindsets, is expected to positively reflect on task performance. Supporting this claim, mindfulness training was found to reduce the occurrence of distracting thoughts during task completion (i.e., mind-wandering), which in turn resulted in reading comprehension and working memory improvements (Mrazek et al., 2013).

In our study, it seems likely that (a) students with higher levels of mindful acceptance were able to free themselves from eventual negative thoughts and feelings associated with writing; and (b) this reduced intrusiveness of thoughts and feelings allowed them to concentrate more on key writing processes, reflected on the production of better texts. In spite of being grounded on other studies, this putative mediating chain – from higher acceptance to better writing via reduction of negative feelings and thoughts – has never been examined before. Additional research is needed to test this hypothesis and provide empirical evidence on the mechanisms through which performance in core school domains (e.g., writing, reading, and math) may benefit from mindfulness. It would be particularly interesting to examine the contribution of other mindfulness facets, besides mindful acceptance. As noted in the literature review, mindfulness also has been conceptualized as a multidimensional construct. For example, it would be particularly insightful to examine whether the five facets of mindfulness proposed by Baer et al. (2006) (viz., observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience) have different contributions to writing achievement.

Limitations and future directions

When interpreting current findings, at least four limitations should be kept in mind. These limitations are presented next, along with indications for future research to overcome them.

First, this is a correlational study, where all variables were measured through single indicators at a single time point. Moreover, for some of these indicators (viz. reasoning, attention, working memory, and planning) we were not able to calculate internal consistency because a single score was extracted from the task. It should, however, be noted that there is robust evidence on the validity and reliability of the tasks here used, including in Portuguese children. Further research should replicate reported results, using experimental designs and/or multiple-indicator approaches.

Second, we did not collect information concerning writing instruction in the participating classes. According to the curriculum, 6th-graders participate in eight hours per week in to of Portuguese Language classes, which focus on four instructional domains (i.e., Orality, Reading and Writing, Grammar, and Literary Education). Within writing, students are expected to produce different genres, using planning-writing-revising sequences (Direção Geral da Educação, 2018). Writing instruction plays a key role in the acquisition and development of writing. Thus, future studies should characterize the specific writing instruction setting of the participating samples and examine how this may influence the link between transcription, executive functions, mindfulness, and writing achievement.

Third, in this study, we intended to do a stringent test to the contribution of mindfulness, after controlling for demographics, transcription, and executive functions. Despite being relevant writing predictors, the final model only explained 38% of the variance in writing achievement, with mindfulness explaining only 3%. In the future, it should be important to ascertain the factors that may explain the remaining variance. Key variables that may deserve further attention are motivation-related factors (e.g., Limpo & Alves, 2017), reading skills (e.g., Taylor & Clarke, 2021), and planning and revising abilities (Limpo & Alves, 2014).

Finally, we failed to find the original one-factor structure of the mindfulness questionnaire (Greco et al., 2011), and only one factor was found to be reliable in the main study. As mindfulness involves

other dimensions besides acceptance (Kabat-Zinn, 2003), our findings provided a partial perspective on the mindfulness-writing link. Future studies are warranted to examine the contribution of other mindfulness components to writing achievement, and to test the extent to which this link may be moderated by a student's grade level and writing proficiency. In a related vein, it should be noted that we only focused on trait mindfulness. However, tapping state mindfulness can also be useful to better understand the mindfulness-writing link.

Practical implications

Findings of the current study provide relevant clues about key skills to target in writing instruction. Teachers should include exercises aimed to improve handwriting fluency and spelling accuracy, even in older students. The benefits of promoting these skills are well-established in the literature (Alves et al., 2016; Graham et al., 2018; Limpo & Alves, 2018). Moreover, teachers should include exercises to foster executive functioning. Given mixed findings about the most relevant executive functions in writing, the implementation of programs tapping multiple executive functions together is advised (Diamond, 2013). Finally, as hinted by the current study and prior experimental evidence (Dunning et al., 2019; Maynard et al., 2017), teachers also should consider the inclusion of mindfulness-based exercises as a complement to the curricular activities. More and more research has been supporting the added value of developing mindfulness in school contexts (Lyons & DeLange, 2016).

Conclusion

This study showed that the successful enactment of a fundamental skill to succeed in school – writing – was predicted by students' ability to approach their own thoughts and feelings with an acceptance orientation. Although the amount of explained variance was reduced (3%), these findings open a new and promising research avenue to the design and testing of writing interventions. The need for multicomponent programs targeting key writing processes was already acknowledged (Limpo & Alves, 2018). Still, for a comprehensive improvement of students' writing skills and ultimately school success, we believe that such programs should also target mindfulness.

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