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CURRICULUM & TEACHING STUDIES | RESEARCH ARTICLE

Does handwriting instruction have a place in the instructional day? The relationship between handwriting quality and academic success

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Abstract: Handwriting is a foundational skill needed by students to demonstrate competency in reading, writing, and math. Occupational therapists who work in schools are tasked with providing remedial services for students who demonstrate deficits in underlying handwriting mechanics, as opposed to deficits in following handwriting conventions. Despite this, therapists frequently find the referred student has none of the expected mechanical constraints, but instead lacks knowledge of letter, number, and punctuation mark formation. This is often an outcome of not being exposed to explicit handwriting instruction. As a result, the researchers sought to determine whether a relationship exists between academic success in reading, writing, and math and the quality of handwriting by comparing standards-based report card grades in reading, writing, and math to scores from the *Handwriting Without Tears Screener of Handwriting Proficiency*. Results indicated a significant positive correlation exists between academic success in writing and reading and quality of handwriting. The implications of this research suggest there is a further need to explore whether instructional time should be allocated for handwriting instruction in the classroom, potentially contributing to increased academic success for students.

ABOUT THE AUTHORS

Hope McCarroll is a school-based occupational therapist in the Dallas, Texas area. She has been working in the public-school system for almost six years. She recently graduated with her doctorate in occupational therapy, specializing in pediatric occupational therapy services. Her current research and project endeavors center on the role of occupational therapists in the public-school system, and continuing research on the need for handwriting instruction as part of the curriculum.

Tina Fletcher is Associate Professor of pediatric occupational therapy at Texas Woman's University in Dallas, Texas. She is a certified school therapy specialist with 28 years of experience. Additionally, she holds an EdD and a MFA. Her current research centers on collaborating with community cultural arts and entertainment venues, exploring best practices for providing opportunities for children with autism and sensory processing disorders to enhance participation.

PUBLIC INTEREST STATEMENT

Handwriting is a vital skill taught in early education and serves various roles as children progress through their years in school. Poor handwriting can negatively influence student performance in academic subjects. Handwriting is the most common reason children are referred for occupational therapy in public schools. Rather than needing therapy for motor or visual deficits, many of these children simply need handwriting lessons. In this study, the authors investigated whether a relationship exists between handwriting quality and academic success in reading, writing, and math. Results showed that handwriting quality has a direct relationship with academic success in reading and writing, but not with math. While this research does not determine that handwriting quality causes academic success, the implications are that instructional time for handwriting should not be abandoned until the repercussions of such a decision are more fully understood.

Subjects: Education; Primary/Elementary Education; Language & Literacy; English & Literacy/Language Arts; Allied Health; Occupational Therapy

Keywords: academic success; classroom instruction; handwriting; instructional time; occupational therapy

1. Introduction

Occupational therapy in public school systems in the United States is considered a special education-related service under the Individuals with Disabilities Education Improvement Act (U.S. Department of Education, 2010). In this setting, occupational therapists help students with disabilities access their education by collaborating with teachers and other members of the education team to meet students' individual goals and objectives. When students struggle with handwriting skills, they are typically referred for occupational therapy services to help remediate a difficulty with underlying deficits in motor coordination, visual perceptual, or visual motor skills (Cahill, 2009; Case-Smith, Holland, Lane, & White, 2012; Clark & Chandler, 2013).

There is also a growing trend for occupational therapists to provide early intervention and response to intervention services including strategies, techniques, and resources for general education teachers to assist students with handwriting struggles in their classrooms (Clark & Chandler, 2013). In addition, occupational therapists can provide district personnel with information that contribute to data-driven administrative decisions regarding use of handwriting instruction curricula in the classroom.

Despite the addition of these new practice areas under the umbrella of related service therapies, handwriting difficulties remain as the most common reason children are referred for school-based occupational therapy (Case-Smith et al., 2012). However, many referred students do not demonstrate the expected motor coordination or visual perceptual deficits typically addressed by therapists. Instead, occupational therapy evaluations reveal some students have not been instructed in correct letter formation. The age-old challenge of teachers' time limitations for handwriting instruction results in quick lessons on finished letterforms instead of teaching the patterns of regular letter formation (Crouwel, 1974). The fact that some schools no longer provide direct instruction in handwriting can contribute to this. The resultant struggle some students have with handwriting may lead to difficulties mastering academics, with a resulting need for the related service of occupational therapy or specialized remedial instruction.

While some school personnel believe handwriting proficiency impacts performance in academic areas such as reading, math, and writing, little research exists to support this claim. To address this gap, the researchers sought to determine if a relationship between handwriting quality and academic performance in reading, math, and writing exists. If this correlation can be demonstrated, further research to determine whether handwriting performance has a direct impact on the quality of academic performance may be warranted. As a future direction for this line of research, if a *causal* relationship can be proven, incorporating handwriting instruction in curricula may serve to improve academic performance, while reducing reliance on the related service of occupational therapy and other specialized remedial instruction. This has the additional benefit of reducing inappropriate referrals that make poor use of school districts' resources of time and funding (Clark & Chandler, 2013).

As an example, in the state of Texas, the *Texas Essential Knowledge and Skills* (TEKS) standards delineates all learning competencies expected of students as they pass through public school. The TEKS (2010) hold that first and second graders are expected to participate in all steps of the writing process, which include planning, drafting, revising, editing, and publishing. As part of this, first grade students are expected to demonstrate foundational skills for proficiency in handwriting by accurately including written conventions of identifying and forming upper- and lower-case letters using left-to-right and top-to-bottom progressions, incorporating spacing between words and sentences, and using readable punctuation marks. While TEKS constructs of legibility and readability leave interpretation to local education agencies, second graders are expected to write legibly and leave appropriate margins for readability. Even though mastery of these elements is specified in the TEKS,

explicit handwriting instructional time is not required, and districts are free to determine how students will meet mastery. As a result, some students struggle with composition, literacy, and math skills that rely on them being expected to follow handwriting conventions to create legible letters, punctuation marks, and numbers (Cahill, 2009; Feder & Majnemer, 2007).

From the early roots of handwriting in colonial America, writing masters understood that students required a good deal of practice to approximate proficient handwriting technique (Thorton, 1998). However, published research on handwriting and its effects on performance in educational subject areas is primarily found within the past 20 years in education literature. Representative research includes the work of Feder and Majnemer, who concluded that writing difficulties are directly associated with lower math scores and lower verbal intelligence quotient. They noted struggling writers had an increase in attentional difficulties, which led to a decrease in academic success and difficulties related to keeping up with the volume of classroom written work (Feder & Majnemer, 2007; Graham, Harris, & Fink, 2000). This echoes the findings of Berninger (1999) and Cahill (2009), who found that when lower level cognitive skills such as handwriting are automatized, a direct effect is made on the overall quality and mastery of higher cognitive skills, such as composition and fluency. In recent years, it was also determined that when working memory and cognitive energy are free, students are more able to focus on the content and fluency of their writing (Cahill, 2009; Puranik & AlOtaiba, 2012).

1.1. Research question

In response to these challenges, as a preliminary step to determining whether or not handwriting proficiency impacts academic success, the researchers focused on discovering whether a relationship exists between handwriting quality and academic success in reading, math, and writing among children who are developing basic skills in handwriting. Therefore, the research question was: Does a relationship exist between academic success in reading, writing, and math and the quality of handwriting when comparing standards-based report card grades in reading, writing, and math to scores from the *Handwriting Without Tears Screener of Handwriting Proficiency*?

2. Method

2.1. Participants

General education first grade ($N = 5$) and second grade ($N = 5$) public school teachers were recruited through convenience sampling at a public elementary school. Inclusion criteria for participant selection included teachers who were designated as a highly qualified teacher (HQT) under the Every Student Succeeds Act of 2016 (ESSA). At the time of this research, HQT personnel must meet state certification requirements under ESSA. In the state of Texas, these requirements include holding a bachelor's degree, completing an educator preparation program, passing certification exams, submitting an application, and submitting fingerprints (Texas Education Agency, 2017a).

Exclusion criteria included not being able to comprehend spoken or written English language, and having no computer access. Teachers who volunteered and met eligibility criteria provided informed consent for participation in this voluntary study, which was approved by the participating local education agency and University Institutional Review Board.

2.2. Setting

This research was conducted in a public elementary school in a small city in the south central United States. The district had nearly 40 campuses and provided educational services to approximately 30,000 students. The district reported that the student ethnic breakdown was approximately half white, followed by Hispanic, then African-American. Additionally, the district reports that 15% of students were bilingual (predominately English- and Spanish-speaking), with the same number reporting limited English proficiency. Over one-third of students were classified as economically disadvantaged, approximately 10% of the students received special education services, and an additional 10% received talented and gifted services. The reported student teacher ratio approached 14:1 (Texas Education Agency, 2017b). The classrooms involved in this research reflected these school district demographics.

2.3. Procedure

Each teacher participant was asked to provide the researchers with de-identified data on academic attainment in reading, math, writing, and handwriting quality for three students in their class whom they considered representative of a low, average, and high academic performer ($N = 3$ for each teacher; $N = 10$ for each grade level; $N = 30$ total students). The state sets classroom size limits of 22 students per class, and each of these classes was considered at or close to capacity. Students were excluded from being considered a representative low, average, and high academic performers if they received specialized supports such as English language instruction, special education, or dyslexia services. This resulted in the scores from approximately 25–30% of the students in each classroom not being eligible for analysis according to exclusion criteria. Therefore, teachers selected works from the 3 representative students for levels of academic performance from a pool of approximately 15 students per classroom.

The researchers were blind to student identities throughout the study. Academic performance and handwriting quality data were collected during an interview that served to ensure the teacher participants understood the process for selecting representative students based on the exclusion criteria.

2.3.1. Academic attainment

Two methods were used to determine academic attainment scores. Academic performance level was subjectively derived from teacher perceptions, and standards-based report card grades reflected objective data derived from state-created knowledge and skills curricula.

2.3.1.1. *Academic performance level.* Teacher participants used their professional reasoning derived from their standing as a highly qualified teacher (HQT) to determine which students best represented low, average, and high performer in the academic content areas of reading, math, and writing.

2.3.1.2. *Standards-based report cards.* Teacher participants were asked to provide the standards-based report card grades for the three selected students in their class. These grades were from the most recent reporting period and included one objective each in math, reading, and writing that teacher participants believed required a foundation of handwriting skills for achieving success.

2.3.2. Handwriting quality

Two methods were used to determine handwriting quality. Similar to using both standardized and subjective measures to determine academic attainment, standardized and subjective sets of measures were used to derive a measure for quality handwriting.

2.3.2.1. *Handwriting Without Tears Screener of Handwriting Proficiency.* To determine handwriting quality for the low, medium, and high academic performers in each of the five first and five second grade classrooms, mid-academic year performance scores from the *Handwriting Without Tears Screener of Handwriting Proficiency* (Handwriting Without Tears, 2000) were used. In this school setting, as a campus-wide diagnostic service, the *Handwriting Without Tears Screener of Handwriting Proficiency* is routinely administered by the campus occupational therapist. This occurs during the beginning, middle, and last six-weeks grading period for all students in first and second grade, and provides teachers with objective data regarding the strengths and weaknesses of both individual students and classrooms as a whole. These pre-existing data were used for the handwriting quality score in this research.

2.3.2.2. *Participant survey.* After all scores on standards-based report cards and handwriting quality were provided to the researcher by the participant teachers, using password-protected campus email to communicate with all participants, each received an invitation to participate in an anonymous online survey of seven questions. Six questions were quantitative in nature, explaining the grade level taught,

handwriting instruction tool used in the classroom, length of time handwriting lessons were taught, quality of students' handwriting, and classroom academic performance in reading, math, and writing (See Table 1).

The survey was designed to assess teacher participants' perceptions of possible relationships between handwriting quality and academic achievement. Participants were advised that data collection would extend over a four-week period. After two weeks passed, a reminder email was sent informing participants they had another two weeks to respond. Ten invitations and survey links were distributed, and eight surveys were completed at the end of the four-week period.

Resulting frequency counts were used to quantify responses to questions one through six, and for the open-ended question regarding teacher perceptions, Charmaz's (2006) method of grounded theory coding was used to derive meanings from the open-ended participant responses. First, two independent reviewers aggregated responses, and then initially coded them by removing any extraneous words or marks. Upon comparing resulting transcripts and finding them identical, the researchers independently coded the responses into data nodes, or units of information, that while not complete in a standard sentence format, can stand as an independent unit of understanding. Again, upon comparing independent analyses, the researchers found their codes nearly identical. After discussing minor variation in their units, or nodes, of information and aligning them so they were identical, they independently coded resulting data nodes for emergent themes (Ritchie, Lewis, Nicholls, & Ormston, 2013, p. 299). Both reviewers compared the emergent themes, and after reviewing original transcripts and preliminary coded data, reached consensus on final themes. The final themes added understandings to teacher participant perceptions on how handwriting quality might be related to academic achievement.

2.4. Measures

2.4.1. Standards-based report cards

Standards-based report cards were developed by the school district to aid in uniform reporting across all campuses. The criteria reported in standards-based report cards derive from state standards for knowledge and skills in all content areas by grade. Scores for the content areas of math, reading, and writing are reported for grades one and two. The standards grow increasingly complex as students attain more skills and knowledge, and each reporting period reflects a new set of competencies with which to measure student achievement. Each student is given a numeric score (1-beginning, 2-developing, 3-meets standards) for their performance in each area. Academic success in math and writing was determined using district report cards which included standard-based objectives for the different subject areas.

2.4.2. Handwriting Without Tears Screener of Handwriting Proficiency

This tool uses web-based software developed for classroom use and intervention development to measure and track critical components of handwriting defined as memory, orientation, placement, and sentence skills. Additionally, it derives an overall scaled score of 1–100. To date, there is no information regarding the psychometric properties of this software according to the researchers' search of academic databases. Although there is no statistical data to drive the use of this tool, it is easy to administer to full classrooms at one time and gives the opportunity for teachers to document and track progress in the classroom.

2.4.3. Teacher survey

Based on their literature review of handwriting and instructional practices, a brief survey was developed by the researchers to gather data regarding teacher perceptions on handwriting quality and academic achievement, with intent to provide researchers with a richer understanding of findings that emerged from the correlational analysis (See Table 1). The first six questions were quantitative in nature, and designed to provide foundational information on teacher perceptions of their classrooms. The final question was open-ended, giving teachers an opportunity to describe their opinions based on their own classrooms and what their thoughts were related to handwriting and academic success.

Table 1. Quantitative participant survey questions

Grade	Handwriting instructional tool	Days per week handwriting is taught	Quality of students handwriting ^a	Classroom academic performance in reading, math, and writing ^b	Length of time handwriting lessons are taught (Including practice time)(min)
1	Handwriting Without Tears	3	4	3	15
1	Handwriting Without Tears	3	4	3	15
2	Writing assignments	3	4	3	10
2	Handwriting Without Tears	1	3	4	15
1	Handwriting Without Tears	3	4	4	15
1	First grade handwriting (Handwriting Without Tears based program)	5	4	4	15
2	Handwriting Without Tears	3	3	3	10
2	Cursive handbook	4	3	3	15

^aQuality of students’ handwriting scale: 1 = very illegible; 2–3 = Average, legible some of the time; 4–5 = Above average, legible writing 100% of the time.

^bAcademic performance scale: 1 = low, most students struggling; 2–3 = Average, some students struggling; 4–5 = High, no students struggling.

3. Results

3.1. Correlational analysis

A correlation analysis was completed using a Spearman’s Rho to determine the relationship between *Handwriting Without Tears Screener* scores and standards-based report card grades in math, reading, and writing. Correlation data are reported in Table 2.

Correlation analysis using Spearman’s Rho showed a significant positive relationship exists between handwriting scores and standards-based report card grades in reading and writing. Significance was found at $p < .01$ between handwriting scores and report card grades for writing at .565. A significant relationship was also found at $p < .05$ between handwriting scores and report card grades for reading at .424. This suggests there is a relationship between handwriting scores and report card grades for reading, and a stronger relationship between handwriting scores and report card grades for writing. Although it was not a topic of inquiry, a significant relationship was also found at $p < .01$ between report card grades for math and writing at .502.

Further exploration using a nonparametric Kruskal–Wallis test revealed a significant relationship exists between student academic performance and handwriting scores, $\chi^2 = 3.677$, $p = .039$ (See Table 3). Students considered high academic performers ($M = 93.30$, $SD = 5.87$) had higher handwriting scores than those who were considered average ($M = 91$, $SD = 4$) or low academic performers ($M = 86.2$, $SD = 7.53$).

3.2. Survey responses

Analysis of the seven survey responses revealed background information on handwriting instruction in the teacher participants’ classrooms. Four of the respondents were first grade teachers and four were second grade teachers. When asked about the number of days per week that handwriting instruction took place in their classrooms, five teachers responded three, one teacher responded one, one teacher responded four, and one teacher responded five days. Teachers were then asked about how long, on average, their handwriting lessons were. Six of the teachers responded that they were

Table 2. Results of Spearman’s Rho comparing handwriting scores and report card grades

	Report card grades (Math)	Report card grades (Reading)	Report card grades (Writing)	Handwriting score
Report card grades (Math)	–			
Report card grades (Reading)	.155	–		
Report card grades (Writing)	.502**	.433*	–	
Handwriting score	.119	.424*	.565**	–

* $p < .05$.

** $p < .01$.

Table 3. Results of Kruskal–Wallis test between academic performance and handwriting scores

	<i>n</i>	<i>M</i>	<i>SD</i>	χ^2	<i>p</i>
Student academic level				3.677	.039
0- Low	10	86.20	7.525		
1- Average	10	91.00	4.000		
2- High	10	93.30	5.870		

15 min, and two teachers responded that they were 10 min. Regarding general legibility, five teachers reported the quality of their students’ handwriting to be above average or legible most of the time. Three teachers reported the quality of their students’ handwriting was considered average or legible some of the time.

Regarding academic performance, teachers were then asked to report on the average academic performance of their class in reading, math, and writing. Three teachers reported their class was considered above average with a few students struggling. Five teachers reported their class was considered average with some students struggling, but they did not quantify this.

Qualitative analysis of narrative participant responses to the survey describing the relationship between handwriting and academic performance they observed in the classroom led to discussions that fell along the following themes: handwriting and academic success, impact of handwriting on other areas of academics, and the impact of lower order skills (handwriting) on higher order cognitive products (the quality of what was produced). Additionally, a variety of opinions related to how and why handwriting instruction is not part of instructional time were put forth.

3.2.1. Handwriting and academic success

In general, participants discussed the relationship of handwriting to academics in positive terms, but were not clearly aligned in their beliefs about a direct relationship between handwriting quality and student success. One participant represented the outlying view that some strong academic performers may have illegible handwriting, which was countered by others’ views that struggling students have the lower handwriting quality. Some questioned whether handwriting was a direct reflection of maturity rather than academic abilities. Three of the eight respondents described the relationship between handwriting quality and academic success as important, and four others reported they felt a relationship did exist to varying extents. Only one participant felt that academic proficiency might not have a direct relationship to handwriting at all.

3.2.2. *Impact of handwriting on other areas*

In regards to how handwriting impacted academic content areas, language arts, reading, and writing were specifically mentioned by half the participants, while other responses were more general, including generic references to “many areas,” in addition to homework, future college success, and employability. When discussing ways to ensure good handwriting in the classroom, participants emphasized the teacher’s position of delivering content, including using evidence-based formalized programs, allocating of special times, and early instruction on specifics such as proper pencil grips. They also considered what the student learner had to allocate in terms of practice, which was specifically mentioned by three participants, and understanding the required task demands.

3.2.3. *Impact of lower order skills (handwriting) on higher order products*

Two participants specifically put forth that the lower order skills of generating letters and numbers impacted final written products. Additionally, some reflected a belief that taking the time to write neatly and more slowly allowed students time to reflect on their written products before submitting them for evaluation. In this context, letter formation and spacing were mentioned. These points are consistent with the foundational skills specified in the TEKS for written expression in lower elementary grades, suggesting that some teachers do understand and support state standards for written conventions.

Participants did point to a number of reasons that handwriting proficiency is not successfully attained in the classroom, including teachers and students having a lack of time available for instruction, that curriculum demands don’t allow for time to be spent in handwriting instruction, and that curriculum specialists themselves don’t place value on incorporating handwriting into instructional times. One participant lamented that handwriting is a dying art and worried about an inevitable technology takeover despite all efforts to the contrary, including using handwriting instruction.

4. Discussion

The results of this research suggest that a relationship does exist between quality of handwriting and academic success in subject areas of reading and writing for this group of students. Of these, there is a stronger relationship between handwriting quality and academic success in the subject area of writing as compared to handwriting quality and academic success in reading. While not a direct answer to this study’s research question, results also indicate a relationship exists between academic success in the subject areas of writing and math. Although the relationship between handwriting quality and academic success in math was not found to be significant, the correlation found between academic success in math and academic success and the subject area of writing could indicate an indirect relationship exists between quality of handwriting and academic success in math.

Qualitative findings generally supported quantitative findings of the significant relationship between handwriting quality and academic success in the subject areas of reading and writing. The majority of participants identified a relationship between quality of handwriting and academic performance and about the need for students to be proficient in the process of letter formation to enable them to focus on the content of their writing. In comparison to the majority of participants who identified a relationship between quality of handwriting and academic performance, the one participant who did not recognize this relationship did not make a significant impact on the results.

5. Limitations

This study was conducted with a small sample size from one public elementary school general education program. While significant correlations were determined among handwriting quality and academic success in reading and writing in first and second graders, this study utilized a small sample, and replicating the study with a larger sample across multiple schools and across various districts would provide generalizable findings.

Because participants' survey responses were anonymous, it was not possible to link student academic performance and handwriting quality to any of the descriptions of the classroom handwriting instruction practices. In light of the variability in handwriting instruction duration and frequency, linking this information to student scores in future research could explore whether or not a handwriting quality screener is impacted by time allocated to handwriting instruction. Considering teacher participants, future research should include a more specific description of the teacher background, since standards for highly qualified teachers are state specific and subject to change.

Moreover, additional data should be collected from various districts and states to help administrators and curriculum directors recognize teachers' perspectives on this topic. To change or alter the instructional day, further research should also be conducted to determine the optimal amount of time needed for direct handwriting instruction. Further research should be used to determine the recommended program or approach that would be best to use for direct handwriting instruction.

6. Conclusions

This study was initially conceived by school-based occupational therapy researchers as a way to better understand why some school districts decide to abandon explicit handwriting instruction in the face of so many students needing remedial supports to assist with not only mechanical constraints, but deficiencies in following handwriting conventions.

Many aspects of this research were guided by subjective data that were collected along with objective data, namely the teacher participant perceptions of students' work and attainment, as well as the relationship between handwriting and academics. While using subjective data can present methodological limitations, it also provides thought-provoking challenges to researchers. For example, this research failed to account for teacher participants' background knowledge and skills regarding the use of technology versus the pen as a primary method of gaining and representing knowledge. Judging by the variations in teacher responses to queries about this, it would be insightful and challenging to systematically explore the beliefs of veteran teachers who came of age in an era where penmanship was valued, and those of newly minted teachers who are either digital immigrants or natives. As Adams (2016) pointed out, the gestural reinforcement received when using a variety of pens, papers, and pencils when writing or during handwriting drills is not that different from the experience of a writer engaged with the tools of graphic communication; the keyboard, the mouse, and the pad. These veteran and newly minted teachers also represent foundational differences that may impact the successful implementation and outcomes of any written/graphic expression instructional practices, for better or for worse.

As school-based occupational therapy researchers, we recognize that the ways we interpret nuances involved in making curricular decisions for school districts may differ from those of our teacher peers. Because of this, we recognize the benefits of not only conducting rigorous trials, but also of inter-professional collaboration. As therapists who support children in their everyday occupations associated with being students, we can sometimes see students or their classrooms from a different vantage point than other school professionals. Our understandings of the human body and thought processes enable us to provide differing ways to frame challenges that arise during the course of a child's school experience. In the case of handwriting instruction, we understand the mechanics of the hand, eye, and mind as related to producing written work. We also understand that teachers have different ways of thinking about written or graphic communication strategies, and about handwriting and its relationship to academic achievement.

The challenge for all of us as educational researchers is to provide district curriculum specialists with relevant and valid evidence to guide their plans for mandating instructional time in content area instruction. Clearly, students in lower elementary grade levels would experience the greatest impact from decisions related to sufficient time learning the basics of written/graphic communication, including handwriting. Until the differences in understanding academic contents by the way they are delivered or expressed are fully understood, the practice of incorporating explicit

handwriting instruction into the elementary student's instructional day should not be abandoned. When handwriting is mastered, it is clear that some students do experience success in writing and reading.

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