

The Relationship Between Handwriting Style and Speed and Legibility

STEVE GRAHAM
NAOMI WEINTRAUB
University of Maryland

VIRGINIA W. BERNINGER
University of Washington

ABSTRACT The relationship between handwriting style and handwriting speed and legibility was investigated. Three samples of writing (narrative, expository, and copying) were collected from 600 students in Grades 4–9. The copying task provided a measure of handwriting speed, and all 3 writing samples were scored for handwriting style (manuscript, cursive, mixed—mostly manuscript, and mixed—mostly cursive) and legibility. The handwriting of students who used a mixed style was faster than the handwriting of the students who used either manuscript or cursive exclusively. In addition, papers written with mixed—mostly cursive letters generally received higher ratings for legibility than papers written with the other 3 styles did. There were no differences between manuscript and cursive in terms of legibility or speed.

The most contested issue in handwriting instruction today centers on the type of script children learn to write. For instance, in the United States, much interest has focused on the use of a slanted manuscript alphabet (D'Nealian script) to facilitate the transition from manuscript to cursive writing. Despite claims to the contrary (Coon & Palmer, 1993), slanted manuscript letters are no more successful than traditional manuscript letters in enhancing the transition to cursive writing or in improving the overall legibility of students' manuscript writing (see Graham, 1992, 1993/1994, for a review of the available evidence).

Considerable attention has also focused on the relative merits of cursive script versus traditional manuscript (Graham & Miller, 1980; Graham & Weintraub, 1996). The available evidence supports the claim that manuscript tends to be more legible than cursive writing (cf. Jackson, 1970; Suen, 1983) but that children and adults write cursive script faster than manuscript (cf. Foster, 1957; Suen, 1983). However, much of the data comparing manuscript and cursive script are dated; the majority of the studies were conducted more than 30 years ago (many in the 1920s and 1930s). Furthermore, findings from several studies challenge the observation that cursive script is produced faster than manuscript. In investigations in which instructional emphasis and practice were held equivalent, both children and adults wrote manuscript as fast as cursive (cf. Hendericks, 1955; Jackson, 1970).

One issue not addressed in the debate on the relative merits of manuscript and cursive writing is that many children and adults do not limit themselves to using manuscript or cursive script exclusively when writing. Tarnopol and Feldman (1987), for example, reported that 59% of the 12th-grade students in their study combined manuscript and cursive script when writing. Only 12% used cursive script exclusively (down from 48% in Grade 9), and 29% used manuscript exclusively. Similarly, in a longitudinal study by Blote and Hamstra-Bletz (1991), the cursive script that Dutch children used when writing changed from a completely joined cursive script to a script with a different style—one that included both joined and unjoined letters. By Grade 6, for instance, only 40% of the girls in their study still used joined cursive letters exclusively (Hamstra-Bletz & Blote, 1990).

In the present study, we examined the effects on handwriting speed and legibility of four styles of handwriting: manuscript, cursive, mixed—mostly manuscript, and mixed—mostly cursive. Three samples of writing were collected from 600 students in Grades 4–9. One sample was acquired by asking students to copy textual material; that sample yielded a measure of handwriting speed. The other two samples were obtained by asking students to respond to narrative and expository writing assignments. All three samples were scored for handwriting style and legibility. These same writing samples were also collected from 300 children in Grades 1–3 but were not included in the current study because there was little variation in handwriting style. First and second graders used manuscript almost exclusively (99%), and third graders relied primarily on manuscript (78%) or mixed—mostly manuscript (19%).

We anticipated that the students who used a combination of manuscript and cursive letters when writing would be faster handwriters than the students who used either manuscript or cursive script exclusively. Previous research has shown that many older children begin to personalize their

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Send correspondence to Steve Graham, Department of Special Education, University of Maryland, College Park, MD 20742. E-mail: SG23@UMAIL.UMD.EDU.

handwriting style after formalized handwriting instruction ends in the primary grades and that these changes are often associated with increased writing speed (Hamstra-Bletz & Blote, 1990; Sassoon, Nimmo-Smith, & Wing, 1987). We assumed that the students who mixed manuscript and cursive letters selected the allographic form of the letter (i.e., manuscript or cursive) that they were able to retrieve and execute most efficiently when writing.

We made no specific prediction concerning the legibility of handwriting, however, because both positive and negative consequences were possible from mixing manuscript and cursive letters when writing. The use of two scripts, for instance, may make a paper more difficult to read. Alternatively, students may select the allographic form of letters that are not only easiest for them to retrieve and produce but also most easily recognizable.

Method

Participants

A sample of 600 children in Grades 4–9 attending schools in the Pacific Northwest participated in the study. Fifty boys and 50 girls were included at each grade level. The students were ethnically diverse: 16% Asian American, 8% Black, 4% Hispanic, 71% White, and 1% Other. We used mother’s education level as an index of socioeconomic status (cf. Wagner, Spratt, Gal, & Paris, 1987). This was the most nonintrusive indicator for this variable that the human subject review board approved. Of the participants’ mothers, 3% had less than a high school education; 18%, high school; 27%, high school plus some continued education; 51%, college or college plus some postgraduate study; and 1%, not reported.

The students in Grades 4–6 (intermediate sample) attended five different urban and suburban schools. Their reading performance on the Word Attack, Word Identification, and Passage Comprehension subtests of the Woodcock Reading Mastery Test–Revised (WRMT–R; Woodcock, 1987) is reported in Table 1. Mean standard scores were within the average range of performance at each grade level. Their mean prorated verbal IQ, based on four subtests (information, similarities, vocabulary, and comprehension) from the Wechsler Intelligence Scale–Revised was also in the average range ($M = 108.4$; $SD = 12.9$). Ten percent of the children were left-handed.

The students in Grades 7–9 (junior high sample) attended two different suburban schools. In contrast to the elementary schools, the two junior high schools did not grant permission to administer achievement and IQ measures for the purpose of describing the participating students. According to the principals of the two schools and the director of research for their district, each school’s achievement tended to be in the average range, based on national norms, on group-administered achievement tests mandated by the district. In each school, the principals ensured that letters of

Table 1.—Students’ Standard Scores on the Woodcock Reading Mastery Test–Revised

Grade	Word attack	Word recognition	Passage comprehension
Fourth			
<i>M</i>	102.58	99.90	96.37
<i>SD</i>	12.94	11.16	12.51
Fifth			
<i>M</i>	105.91	104.04	101.66
<i>SD</i>	12.46	11.43	14.57
Sixth			
<i>M</i>	107.18	105.44	102.37
<i>SD</i>	11.67	11.45	13.21

Note. The Woodcock Reading Mastery Test–Revised has a *M* of 100 and an *SD* of 15; at each grade level, $n = 100$.

opportunity to participate were given to students in slow-, average-, and fast-moving tracks. The resulting sample appeared to reflect the normal range of achievement at the junior high level for schools in which average performance approximates the national average. Eight percent of the children were left-handed.

Procedures

Three samples of handwriting were collected from each student. One handwriting sample was obtained via the Copying subtest from the Group Diagnostic Reading Aptitude and Achievement Tests (Monroe & Sherman, 1966). With this subtest, the child is asked to copy a short paragraph as quickly as possible without making any mistakes. The student is asked to stop copying at the end of 1.5 min. In the present study, the paragraph was printed at the top of a page and the student copied it on the writing lines below.

The other two handwriting samples were obtained by asking each child to generate two compositions, one narrative and the other expository. For both free-writing tasks, the student was asked to write about a familiar topic. For the narrative task, the student was asked to complete the choices in the following topic frame and then continue writing the story for 5 min: “One day (**choose person**) had the (**choose best or worse**) day at school.” For the expository task, the student completed the choices in the following topic frame and then continued writing the essay for 5 min, explaining “I like (**choose person, place, or thing**) because ____.” Once the 5-min time interval had elapsed, the student made a slash mark after the last letter written but was allowed to complete the sentence being worked on. Only the material generated during the 5-min writing interval (before the slash) was scored in the subsequent analyses of the two free-writing tasks. The order of the two free-writing tasks was counterbalanced.

On all three handwriting tasks, the students were told that

they needed to write throughout the specified time period. If a student stopped writing, the examiner encouraged the student to continue writing. It was rarely necessary to prompt students to write during the assigned interval. Furthermore, the children never seemed anxious and appeared to enjoy the three handwriting tasks, even though their performance was timed during each task.

Handwriting Measures

Speed. We obtained a measure of handwriting speed by counting the number of letters copied correctly in 1.5 min on the Copying subtest from the Group Diagnostic Reading Aptitude and Achievement Tests. The number of correctly copied letters was then divided by 1.5 min to obtain an index of the number of letters copied correctly per minute. To establish interobserver reliability, we rescored for handwriting speed handwriting samples from 20 students (10 boys and 10 girls) at each grade level from the copying task. Interobserver reliability was .99.

Legibility. We used the scales from the Test of Legible Handwriting (TOLH; Larsen & Hammill, 1989) to establish the overall legibility of each of the three handwriting samples (copying and two free-writing samples). With this test, a handwriting sample is matched as closely as possible to a set of graded specimens with scores that range from 1 to 9. The higher the score, the more legible the writing sample.

Two teachers independently scored all handwriting samples. They were told that the sole consideration in making the match between a handwriting sample and the graded specimens from the TOLH was handwriting legibility. They were also told that slant, spacing, letter formation, size, and so forth, were important only if they contributed to or distracted from handwriting legibility and that no single attribute should be singled out for special emphasis. The two raters were further instructed to ignore writing features such as literary merit, spelling, word usage, grammar, and so forth, and to focus exclusively on the physical aspect of the handwriting sample.

Before scoring the handwriting samples collected in the present study, the two teachers participated in a training session where the TOLH scoring procedures were modeled and practiced. At the end of the training session, the two teachers used the graded specimens from the TOLH to independently score 20 handwriting samples. Interobserver reliability during training was .92. More important, the two raters maintained high levels of interobserver reliability as they scored the handwriting samples from the current study. For all 1,800 handwriting samples, interobserver reliability was .87. Furthermore, at all grade levels (4–9), interobserver reliability was always above .80 for each of the three writing tasks.

Handwriting style. Each handwriting sample was examined to determine the style of handwriting—manuscript or cursive—used by the writer. Samples were classified as manuscript (all letters manuscript), cursive (all letters cur-

sive), mixed—mostly manuscript (50% or more manuscript), and mixed—mostly cursive (50% or more cursive). At each grade level, the handwriting samples of 20 students (10 boys and 10 girls) for each handwriting task were rescored. Interobserver reliability for classification of style of handwriting was .99, .98, and .99 for copying, narrative writing, and expository writing, respectively.

Results

Table 2 contains means and standard deviations for handwriting speed and handwriting legibility for each style of handwriting. Table 3 contains the percentage of students at each grade using each style of handwriting on the three writing tasks. Overall, manuscript (31%), cursive (30%), and mixed—mostly manuscript (30%) occurred with approximately equal frequency when all grades and handwriting samples were combined. In contrast, mixed—mostly cursive occurred 9% of the time. These same patterns of distribution occurred for each type of writing sample as well (see Table 3). In addition, the use of manuscript began to decline only in the upper grade levels when the use of mixed—mostly manuscript increased.

Speed of Handwriting

We examined the relationship between handwriting speed on the copying task and handwriting style on the copying task with a $4 \times 6 \times 2 \times 2$ (Style \times Grade \times Sex \times Handedness) analysis of variance (ANOVA). We were interested primarily in the main effect for style and interactions among style, grade, sex, and handedness on the dependent measure—speed of handwriting on the copying task. The main effects for style, $F(3, 558) = 17.34, p < .000$ ($MSE = 314.96$); grade, $F(5, 558) = 140.90, p < .000$ ($MSE = 314.96$); and sex, $F(1, 558) = 25.10, p < .000$ ($MSE = 314.96$), were significant. None of the interactions among the independent variables or the main effect for handedness was significant.

Post hoc analyses using Tukey's HSD test showed that the students who completed the copying task using mixed—mostly manuscript wrote faster than the students who used just manuscript or cursive script when copying text (all $ps < .05$). Text copied with mixed—mostly manuscript was written approximately 19 letters per minute faster than text copied in cursive (effect size = .64) and 16 letters per minute faster than text copied in manuscript (effect size = .74; see Table 2). Similarly, the students who used mixed—mostly cursive writing on the copy task wrote faster than the students who used just manuscript or cursive when copying (all $ps < .05$). Text copied with mixed—mostly cursive was written approximately 13 letters per minute faster than text copied in cursive (effect size = .48) and 10 letters per minute faster than text copied in manuscript (effect size = .40; see Table 2). No other significant differences were noted.

Thus, as predicted, the students who used a combination

Table 2.—Handwriting Speed and Legibility

Measure	Manuscript	Mostly manuscript	Cursive	Mostly cursive
Speed				
Copying				
<i>M</i>	88.21	103.96	84.81	97.87
<i>SD</i>	25.49	26.21	26.94	32.21
Legibility				
Copying				
<i>M</i>	4.28	3.97	4.36	4.51
<i>SD</i>	1.40	1.29	1.30	1.47
Narrative				
<i>M</i>	3.82	3.91	4.01	4.70
<i>SD</i>	1.23	1.30	1.32	1.49
Expository				
<i>M</i>	3.90	3.99	4.06	4.39
<i>SD</i>	1.20	1.34	1.42	1.45

Note. *n* = 600 students in Grades 4–9.

Table 3.—Percentage of Students Using Each Style of Handwriting on the Three Writing Tasks

Grade	Manuscript	Mostly manuscript	Cursive	Mostly cursive
Fourth				
Copy	41	18	3	38
Narrative	41	23	35	1
Expository	38	22	38	2
Total	40	21	25	14
Fifth				
Copy	36	25	34	5
Narrative	40	30	27	3
Expository	38	29	30	3
Total	38	28	30	4
Sixth				
Copy	28	22	37	13
Narrative	33	30	25	12
Expository	34	27	25	14
Total	32	26	29	13
Seventh				
Copy	36	27	34	3
Narrative	32	36	25	7
Expository	37	30	27	6
Total	35	31	29	5
Eighth				
Copy	19	33	40	8
Narrative	27	36	25	12
Expository	29	31	31	9
Total	25	33	32	10
Ninth				
Copy	13	42	35	10
Narrative	15	45	30	10
Expository	18	41	30	11
Total	15	43	32	10

Note. At each grade level, *n* = 100.

of manuscript and cursive letters when writing were faster handwriters than the students who used either manuscript or cursive script exclusively. In addition, the significant main effects for sex and grade confirmed previous research showing that girls are faster writers than boys and that speed of handwriting improves as children mature (Dobbie & Askov, 1995; Graham & Weintraub, 1996).

Handwriting Legibility

We used three 4 × 6 × 2 × 2 (Style × Grade × Sex × Hand- edness) ANOVAs to examine the relationship between legibility and handwriting style. A separate analysis was completed for each type of writing task (i.e., copying, narrative, and expository), and the dependent measure for each analysis was

the legibility score for that task. As in the previous analysis, we were interested primarily in the main effect for style and the interactions among style, grade, sex, and handedness.

For the copying task, the main effects for style, $F(3, 558) = 5.51, p < .001$ ($MSE = 1.46$); grade, $F(5, 558) = 10.91, p < .000$ ($MSE = 1.46$); and sex, $F(1, 558) = 93.41, p < .000$ ($MSE = 1.46$), were significant. None of the interactions among independent variables or the main effect for handedness was significant.

Post hoc analyses using Tukey's HSD test showed that the students who completed the copying task using mixed-mostly cursive produced handwriting of higher legibility than students who copied using mixed-mostly manuscript ($p < .05$). Text copied with mixed-mostly cursive received a legibility rating .4 points higher than text copied in mixed-mostly manuscript (effect size = .31; see Table 2). No other significant differences were noted.

For the narrative writing task, the main effects for style, $F(3, 558) = 14.70, p < .000$ ($MSE = 1.39$); grade, $F(5, 558) = 4.90, p < .000$ ($MSE = 1.39$); and sex, $F(1, 558) = 101.43, p < .000$ ($MSE = 1.39$), were significant. None of the interactions among independent variables or the main effect for handedness was significant. Post hoc analyses using Tukey's HSD test showed that the students who wrote their narratives using mixed-mostly cursive produced handwriting of higher legibility than the students who wrote using manuscript, mixed-mostly manuscript, or cursive (all $ps < .05$). Narrative text written with mixed-mostly cursive received a legibility rating almost .9 points higher than narrative written in manuscript (effect size = .72), almost .8 points higher than mixed-mostly manuscript (effect size = .61), and almost .7 points higher than cursive (effect size = .52; see Table 2). No other significant differences were noted.

For the expository task, the main effects for style, $F(3, 558) = 2.66, p < .05$ ($MSE = 1.49$); grade, $F(5, 558) = 5.28, p < .000$ ($MSE = 1.49$); and sex, $F(1, 558) = 90.57, p < .000$ ($MSE = 1.49$), were significant. None of the interactions among independent variables or the main effect for handedness was significant. Post hoc analyses using Tukey's HSD test showed that the students who wrote expository papers using mixed-mostly cursive produced handwriting of higher legibility than the students whose papers were written in just manuscript ($p < .05$). Expository text written with mixed-mostly cursive received a legibility rating almost .5 points higher than papers written in manuscript (effect size = .41; see Table 2). No other significant differences were noted.

Thus, for the most part, legibility of handwriting was not influenced by handwriting style. The only exception involved mixed-mostly cursive script. This style of handwriting yielded the highest legibility ratings on all three writing samples and was statistically superior to manuscript on the two free-writing samples, mixed-mostly manuscript on the narrative and copy samples, and cursive on the narrative sample. As with handwriting speed, the significant main effects for sex and grade for the three legibility measures confirmed previous research showing that the legibil-

ity of girls' handwriting is better than that of boys' handwriting and that overall legibility of handwriting changes as children mature (Graham & Weintraub, 1996).

Consistency of Style

On the two free-writing samples (narrative and expository), the students used the exact same style of writing 92% of the time. Another 5% of the time, the students were mostly consistent; that is, manuscript was used on one and mixed-mostly manuscript on the other or cursive on one and mixed-mostly cursive on the other.

On the narrative and copying samples, the students used the exact same style of writing 80% of the time and were mostly consistent another 10% of the time. Likewise, the students used the same style of writing on the expository and copying samples 80% of the time and were mostly consistent another 10% of the time. Thus, across different writing tasks, the students regularly used the same style of writing or one that was very similar.

Discussion

Our purpose in the present study was to examine the relationship between handwriting style and handwriting speed and legibility. As predicted, the students who used a combination of manuscript and cursive letters when writing were more fluent handwriters than the students who used either manuscript or cursive script exclusively. This advantage was robust, occurring when mixed script was either mostly manuscript or mostly cursive.

One potential drawback to mixing manuscript and cursive letters is that the overall legibility of a paper may suffer. This did not occur in the present study; the legibility of mixed script was either equivalent or superior to both manuscript and cursive script. There was no statistically significant difference in the overall legibility of papers written with a mixed script of mostly manuscript letters and those written in manuscript or cursive script exclusively. Likewise, there were no statistically significant differences in the legibility of papers copied with a mixed script of mostly cursive letters and those copied in either manuscript or cursive. On the two free-writing tasks (narrative and expository), however, the legibility of papers written with mixed script of mostly cursive letters was superior to that of papers written with only manuscript or only cursive script. The only exception involved expository writing, where there was no statistically significant difference in the legibility of papers written with cursive or mixed script of mostly cursive letters.

Even though the handwriting of the students who mixed manuscript and cursive was faster and sometimes qualitatively better, the majority of the participating students' papers were written with manuscript or cursive script exclusively. Nevertheless, a sizable proportion of papers (almost 40%) were written with a combination of manuscript and cursive letters. When students mixed scripts, they were

three times more likely to use manuscript as the predominate letter form. Although the handwriting speed of the students who used the two forms of mixed script did not differ statistically, narrative and copy papers with mostly cursive letters received higher overall legibility ratings than those produced with mostly manuscript letters.

The findings of the present study are consistent with observations made by other researchers that many students' style of handwriting deviates from the form they were initially taught in the primary grades (Blote & Hamstra-Bletz, 1991; Tarnopol & Feldman, 1987). Deviations in handwriting form and style are not necessarily a cause for concern, however, as an increasing number of such deviations have been associated with faster writing speed. Changes or deviations associated with faster handwriting include altering letters to eliminate clockwise movements (Hamstra-Bletz & Blote, 1990; Hollerbach, 1981), modifying the connections between letters (Sassoon et al., 1987), slightly curving straight lines and avoiding strong curvatures (Meulenbroek & van Galen, 1990), and, in the current study, using a mixture of manuscript and cursive letters. Although it is not clear if these changes were responsible for increased handwriting speed or were a consequence of it, strict adherence to a particular style or form of handwriting cannot be recommended and would likely frustrate both the teacher and the child.

In contrast to previous findings that manuscript is more legible than cursive writing (cf. Jackson, 1970; Suen, 1983; Templin, 1958) and cursive is written faster than manuscript (cf. Foster, 1957; Suen), there were no statistically significant differences in the speed or legibility of these two forms of handwriting in the present study. This discrepancy may have occurred because of differences in how samples were categorized as manuscript or cursive. Prior investigators simply categorized writing samples as either manuscript or cursive, failing to create separate categories for samples including both manuscript and cursive letters (as was done in the present study). To test the strength of this explanation, we reanalyzed our data using the classification system used in previous research: Samples were classified as either manuscript or cursive based on the formation of 50% or more of the letters. Contrary to our expectations, results of these reanalyses were at odds with findings from previous research as well as findings in the present study. Manuscript was written faster than cursive, $F(1, 599) = 19.42, p < .000$ ($MSE = 802.48$), and the legibility of samples classified as cursive was superior on the narrative assignment, $F(1, 599) = 7.00, p < .01$ ($MSE = 1.71$), and the copying task, $F(1, 599) = 5.37, p < .05$ ($MSE = 1.81$). Thus, the system used to classify samples as manuscript or cursive can influence a study's outcomes. This does not, however, provide a likely explanation for the discrepancy between the present findings and previous observations because the results based on the reclassification are in the opposite direction of prior findings.

Finally, the findings from the present study were not mediated by children's grade, sex, or handedness; there

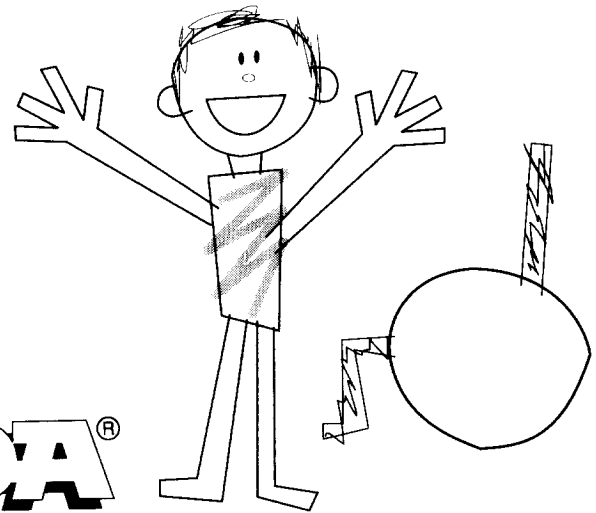
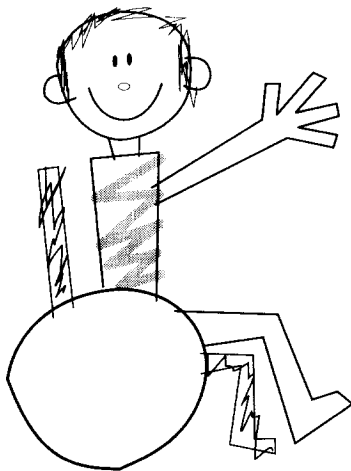
were no statistically significant interactions between these variables and handwriting style in terms of legibility or speed. Despite the generality of the findings from this study, replication and additional investigation is needed to more fully understand the relationship between handwriting speed and legibility and variations in handwriting style and form. Of particular importance is research examining the development of fluency in handwriting. Recent research has shown that measures of handwriting fluency account for 25–42% of the variance in the writing quality of elementary-grade children (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997) and that students' fluency in generating written text can be boosted by improving their handwriting (Berninger et al., 1996). Continued study of children's departures from the taught form of handwriting should prove a fruitful area of investigation; these changes may reflect a general search by the writer for a more efficient and fluent style of handwriting (Sassoon et al., 1987).

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