

Pencil Grips, Legibility, and Speed of Fourth-Graders' Writing in Cursive

Susan M. Koziatek,
Nancy J. Powell

KEY WORDS

- classroom tool use
- cursive handwriting
- school-based therapy

OBJECTIVE. The purpose of this research was to study how the speed and legibility of fourth-grader's handwriting was affected by type of pencil grip on the Evaluation Tool of Children's Handwriting-Cursive.

METHOD. Ninety-five typically developing students and 6 students receiving special education services completed the Evaluation Tool of Children's Handwriting-Cursive (ETCH-C). Photographs were taken of their pencil grips while they wrote the alphabet. One-way ANOVAs were calculated to compare legibility rates and writing speeds by type of pencil grip.

RESULTS. Ninety-nine of the students used one of four pencil grips including the dynamic tripod (38 students), the dynamic quadrupod (18), the lateral tripod (22), and the lateral quadrupod (21). One student used the four-finger pencil grip and one used the interdigital pencil grip. Mean cursive writing speeds were similar for all pencil grips except for the interdigital grasp. Speeds obtained were slower than recently published fourth-grade speeds ranging from a mean of 29.45 to 34.75 letters per minute.

CONCLUSION. This study found the lateral quadrupod and four-finger pencil grips to be as functional as the dynamic tripod, lateral tripod, and dynamic quadrupod pencil grips. This study provides average handwriting speeds for fourth-grade students on the ETCH-C.

Koziatek, S. M., & Powell, N. J. Pencil grips, legibility, and speed of fourth-graders' writing in cursive. *American Journal of Occupational Therapy*, 57, 284-288.

Susan M. Koziatek, MS, OTR, is Staff Occupational Therapist, Auxiliary and Preschool Services Center, Macomb Intermediate School District, Department of Support and Related Services, 47425 Freedom Valley Drive, Macomb, Michigan 48044-2564; skoziatek1@aol.com.

Nancy J. Powell, PhD, OTR, FAOTA, is Assistant Professor, Center for Healthcare Effectiveness Research, Wayne State University, Detroit, Michigan.

It is the responsibility of teachers and school-based occupational therapists to decide when handwriting legibility, speed, and pencil grip are functional for educational needs (Tseng, 1998). Empirical evidence describing the effects of various pencil grips on handwriting legibility and speed is essential to evidence-based practice (Schneck, 1988). Researchers have attempted to classify the developmental progression and effects of pencil grip (Schneck, 1988; Tseng).

Recently, Tseng (1998) developed a comprehensive pencil grip classification system following her study of pencil grip development in Taiwanese preschoolers. This classification expands on Schneck's 1988 doctoral study of pencil grip. Tseng's classification system divides development of pencil grip into three stages: primitive, transitional, and mature. Her findings supported studies that found the lateral tripod and dynamic quadrupod to be mature pencil grips equal to the dynamic tripod in legibility and or speed scores or both (Parush, Levanon-Erez, & Weintraub, 1998; Ziviani & Elkins, 1986). Dennis and Swinth (2001) also found the lateral quadrupod to be as functional as the dynamic tripod in their study of pencil grip.

School-based occupational therapists need empirical evidence on mean handwriting speeds per grade and style of handwriting, so they can identify when a student's speed is impeding success in written work. Although researchers have published handwriting speeds for fourth graders (Graham, Berninger, Weintraub, & Schafer, 1998; Ziviani & Watson-Will, 1998), most are of speeds for printing or a

combination of printing and cursive. Only Phelps, Stempel, and Speck's (1985) study describes mean speeds by fourth graders writing only in cursive, but not using the Evaluation Tool of Children's Handwriting-Cursive (ETCH-C) (Amundson, 1995). Most of the speeds reported in the literature are for other handwriting assessments with different writing tasks and may not be appropriate for comparison to speeds obtained on the ETCH-C.

As the ETCH-C is becoming a popular handwriting assessment for school-based occupational therapists to use, the purpose of this study was to investigate the pencil grips, legibility scores and cursive writing speeds of fourth-grade students on the ETCH-C. This study aimed to answer the following research questions:

1. What pencil grips do fourth-grade students use when completing the ETCH-C, and how do these pencil grips compare for legibility and speed scores?
2. What mean speed scores do fourth-grade students achieve on the ETCH-C?

Method

Sample

As described previously by the authors, the primary study was a correlational research study using a comparison group design examining the validity of the ETCH-C (Koziatek & Powell, 2002). The sample consisted of 95 typically developing students, five students certified with a speech and language impairment and one student who had both a hearing impairment and a learning disability, from a large suburban school district in a metropolitan area. Following approval from human subjects committee, full consent and assent was obtained for 43.6% of the fourth graders registered in the four schools participating in the study. The participants ranged in age from 9.0 years to 10.7 years with a mean age of 9.2 years. Fifty-six percent of the participants were girls and 44% were boys. Ninety-three percent were right-handed and 7% left-handed. Seventy-eight percent were Caucasian, 13% East Indian, 4% Asian, 3% black, and 2% Hispanic.

Instrument

The ETCH-C (Amundson, 1995) is a criterion-referenced handwriting assessment with standardized administration and scoring procedures. The ETCH-C addresses a variety of handwriting tasks students perform in the classroom including: writing the lower and upper case alphabet from memory, writing numbers from memory, near-point copying, far-point copying, manuscript to cursive transition, dictation, and sentence composition.

Procedure

Students' score sheets were coded to maintain confidentiality and they were given a sharpened #2 pencil before completing the ETCH-C. The first author administered the ETCH-C according to standardized directions to fourth-grade students individually in an area of the building outside the student's classroom.

While the students were copying the upper and lower case alphabets, the researcher took a photograph of each student's pencil grip using a Samsung Impax 200i APS camera from a radial view in the close up setting at a distance of 12 to 18 inches. The pencil grip photographs were commercially developed into 3" by 5" color prints for data analysis.

Scoring of response booklets was performed in random order by the researcher who had met ETCH-C criteria for scoring competence (Amundson, 1995). The researcher scored the response booklets while blind to the student's identity to obtain total legible words and letters percentage scores by dividing the total number of legible letters or words by the total number of letters or words possible according to ETCH-C standardized scoring directions (Amundson). The researcher converted seconds to minutes and then divided the number of letters written by the minutes taken to obtain the letters per minute speed for all timed tasks. She then calculated an average speed for each student by summing the speed scores and dividing by the four timed tasks.

The pencil grip photographs were used to determine each participant's pencil grip for data analysis. First, the researcher assigned a number to each type of pencil grip identified in Tseng's (1998) pencil grip classification, and then she and another school-based occupational therapist assigned a pencil grip name and number to each of the pencil grip photographs. However, as they were attempting to classify the pencil grips, a new pencil grip not listed in Tseng's (1998) classifications was observed and given a number. This pencil grip was named the lateral quadrupod pencil grip (Figure 4). Dennis and Swinth (2001) also identified the lateral quadrupod pencil grip in their study concerning the effect of pencil grip on legibility. The researcher compared her pencil grip classifications with the other therapist's and found a 76% agreement rate. The researcher and school-based therapist reviewed Tseng's pencil grip definitions and determined a final pencil grip classification collaboratively to resolve non-agreements.

Data Analysis

First, the researcher ran a frequency distribution to identify each type and the frequency of pencil grips used by the

fourth graders. Next, the researcher calculated ranges of speed and mean speeds in letters per minute by pencil grips to evaluate tendencies and differences between the pencil grips. Then the researcher calculated the ranges and means of total word and letter legibility scores before converting the decimal scores to percentages by pencil grips.

Finally, one-way ANOVAs were calculated for ETCH-C total legible words and letters scores and ETCH-C speed scores by pencil grip. The data for the four-finger pencil grip and the interdigital pencil grip was excluded because there was only one subject in each of those groups.

Results

Thirty-eight of the fourth graders used the dynamic tripod pencil grip (Figure 1), 18 used a dynamic quadrupod pencil grip (Figure 2), 22 used a lateral tripod pencil grip (Figure 3), 21 used a lateral quadrupod pencil grip (Figure 4), one used a four-finger pencil grip (Figure 5), and one used an interdigital pencil grip (Figure 6). Speed scores ranged from 13 to 75 letters per minute (Table 1). All mean speed scores were similar when comparing them by pencil grip except for the speed of the student using the interdigital pencil grip (Table 1).

Table 1. Descriptive Statistics of Speed Scores on the ETCH-C by Pencil Grip ($n = 101$).

Pencil Grip	n	Mean LPM	Standard Deviation	Range in LPM	
				Minimum	Maximum
Dynamic Tripod	38	29.45	9.84	13.00	54.00
Dynamic Quadrupod	18	33.04	11.78	13.50	52.00
Lateral Tripod	22	32.00	11.06	15.75	55.25
Lateral Quadrupod	21	33.54	13.62	16.25	75.00
Four-Finger	1	34.75			
Interdigital	1	14.25			

Note. The mean speed scores are the average of speed scores in letters per minute (LPM) for all students using that type of pencil grip on the ETCH-C tasks III, IV, V, and VII. The ranges are the lowest and highest average speed scores for the test obtained by the students using that type of pencil grip. The frequency of occurrence for each pencil grip is represented by n .

Fourth graders using the lateral quadrupod pencil grip scored highest for both total word (94.09%) and total letter legibility (90.81%) of all students using mature pencil grips. Mean total word legibility scores were 86.48% for the dynamic tripod, 86.00% for the dynamic quadrupod and 89.43% for the lateral tripod pencil grips. Mean total letter legibility was 88.81% for the dynamic tripod, 86.50% for the dynamic quadrupod and 90.81% for the lateral tripod pencil grips. The one student who used the four-finger pencil grip obtained scores of 100% total word and 94.15% total letter legibility. The one student who used the inter-



Figure 1. The Dynamic Tripod Pencil Grip (Tseng, 1998).



Figure 2. The Dynamic Quadrupod Pencil Grip (Tseng, 1998).



Figure 3. The Lateral Tripod Pencil Grip (Tseng, 1998).



Figure 4. The Lateral Quadrupod Pencil Grip (Dennis & Swin, 2001).



Figure 5. The Four-Finger Pencil Grip (Tseng, 1998).



Figure 6. The Interdigital Pencil Grip (Tseng, 1998).

digital pencil grip achieved a total word legibility of 79.31% and a total letter legibility of 83.16%.

Results of One-way ANOVA calculations revealed no statistically significant difference between the dynamic tripod, dynamic quadrupod, lateral tripod, and lateral quadrupod pencil grips for ETCH-C total word legibility $F(3, 95) = 1.85, p = .14$, ETCH-C total letter legibility $F(3, 95) = .90, p = .44$, and ETCH-C speed scores $F(3, 95) = .76, p = .52$. The four-finger and interdigital pencil grip data were not included (sample size).

Discussion

This study and Dennis and Swinth's study (2001) identified a new pencil grip, the lateral quadrupod, to add to the mature section of Tseng's (1998) classification system. The findings of no statistically significant differences in legibility and speed scores among the four mature pencil grips strengthens the argument that the dynamic quadrupod, lateral tripod, and lateral quadrupod should be considered mature pencil grips equal in function to the dynamic tripod. As only one student used a four-finger pencil grip, no conclusions can be drawn on whether or not it is a mature pencil grip. The scores obtained by the student using the four-finger pencil grip in this study were similar to those of the mature grips. These findings do not support Tseng's transitional classification of the four-finger pencil grip (Tseng). The student who used the primitive interdigital pencil grip had lower speed and legibility scores than the students using the other pencil grips. However, the student using the interdigital pencil grip did not have the lowest speed score in the sample as the lows for the dynamic tripod and dynamic quadrupod ranged from 13.00 and 13.50 letters per minute, so his slower speed score could have been caused by performance components not measured in this study.

Phelps et al. (1985) observed a large range (7 to 73 letters per minute for fourth graders) in speed scores. Despite the large differences in the range of speed scores achieved in this study (13 to 75 letters per minute), the mean speeds for the four mature and the four-finger pencil grips were quite similar varying from only 29.45 to 34.75 letters per minute (Table 1).

This study provides speed scores on the ETCH-C for fourth graders with 1 year of cursive writing experience. The speeds achieved by the students in this study are lower than the 57 to 63 letters per minute mean speeds achieved recently by fourth graders from other studies using different handwriting assessments (Graham et al., 1998; Ziviani & Watson-Will, 1998). However, the speeds in this study approximate the 37 letters per minute mean speed achieved

by fourth graders using cursive in Phelps et al. (1985) study. This finding lends support to the need to investigate, document and publish speeds achieved by students on the ETCH-C.

Limitations and Directions for Future Research

The narrow age range and use of one geographic area limit generalizability of results in this study. The imbalance of pencil grip group sizes limited statistical analysis.

Further research is needed on the relationship between pencil grips and handwriting legibility and speed. For example, now that accepted terminology for naming types of pencil grips is available, additional studies are needed to support the current study's findings and to compare the legibility and speed scores for students using mature pencil grips, transitional pencil grips, and primitive pencil grips. Findings suggest that therapists and teachers need to recognize that although a student's pencil grip may be considered atypical, such a grip is not automatically less functional than the dynamic tripod. Further research is needed to investigate and document manuscript and cursive ETCH speed scores from students of other grades, so therapists using the ETCH can make intervention decisions based on actual ETCH speed scores instead of having to compare ETCH speeds to speed scores obtained on other handwriting tests. ▲

Acknowledgments

We thank the students, parents, teachers, and administrators of the Warren Consolidated School District who approved of and participated in the study. We thank Lisa Burzynski, MAT, OTR for her assistance with establishing the reliability of scoring and pencil grip classifications. This study was conducted in partial fulfillment of the first author's requirements for a Master of Science Degree, Department of Occupational Therapy, Wayne State University, Detroit, Michigan.

References

- Amundson, S. J. (1995). *Evaluation tool of children's handwriting*. Homer, Alaska: O.T. KIDS, Inc.
- Dennis, J. L., & Swinth, Y. (2001). Pencil grasp and children's handwriting legibility during different length writing tasks. *American Journal of Occupational Therapy*, 55, 175–183.
- Graham, S., Berninger, V., Weintraub, N., & Schafer, W. (1998). The development of writing fluency and legibility in grades 1 through 9. *Journal of Educational Research*, 92, 42–52.
- Koziatek, S. M., & Powell, N. (2002). A validity study of the Evaluation Tool of Children's Handwriting-Cursive. *American Journal of Occupational Therapy*, 56, 446–453.

- Parush, S., Levanon-Erez, N., & Weintraub, N. (1998). Ergonomic factors influencing handwriting performance. *Work, 11*, 295–305.
- Phelps, J., Stempel, L., & Speck, G. (1985). The children's handwriting scale: A new diagnostic tool. *Journal of Educational Research, 79*, 46–50.
- Schneck, C. M. (1988). Developmental changes in the use of writing tools in normal 3.0 to 6.11 children and first grade children with handwriting problems. (Unpublished Doctoral Dissertation). Boston, MA: Sargent College Of Allied Health Professions, Boston University. Abstract from [online] OT Search, call number W 4A.S193d 1988. Dissertation available on loan from Wilma West Library.
- Tseng, M. H. (1998). Development of pencil grip position in preschool children. *Occupational Therapy Journal of Research, 18*, 207–224.
- Ziviani, J., & Elkins, J. (1986). Effect of pencil grip on handwriting speed and legibility. *Educational Review, 38*, 247–257.
- Ziviani, J., & Watson-Will, A. (1998). Writing speed and legibility of 7–14 year old school students using modern cursive script. *Australian Occupational Therapy Journal, 45*, 59–64.