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OBJECTIVE. The purpose of this study was to guide teachers and occupational therapist in recognizing handwriting needs in order to provide appropriate early intervention support for handwriting.

METHOD. 218 kindergarten students in a public school district were screened for handwriting ability using the Handwriting Without Tears and the Public School's copy screeners. Students were assessed three times during the 2014 to 2015 school year on letter memory, line placement, letter orientation, copy legibility, and copy placement skills.

RESULTS. The results indicated that winter scores were a better predictor of spring scores. Significant effects in four out of five variables were found when utilizing repeated measures of retrospective data.

CONCLUSION. Winter scores were shown to be significant in determining handwriting outcomes measured in the spring. The Handwriting Without Tears' screener and the Public School's screener are appropriate tools for school-based occupational therapists to use to identify intervention needs.

Key Words:

- Handwriting Without Tears Screener
- Handwriting difficulties

Referrals to school-based occupational therapists (SBOTs) often stem from handwriting difficulties in students (Case-Smith, Holland, Lane, & White, 2012). In schools, handwriting is the primary way students display information learned (Donica, 2010). School success is often determined by the child's ability to master the fundamentals of handwriting (Schneck, Shasby, Myers, & DePoy Smith, 2012). The ability of the child to write legibly and quickly is essential to the functional skills of writing their name, filling out an application, drawing a picture, or taking notes. Even with the advancements in technology (Thompson, McLaughlin, Derby, & Conley, 2012), handwriting in the form of note taking, message taking, writing examinations, and completing applications are important life skills. Overall, handwriting is a functional activity that impacts an individual's satisfaction, creativity, productivity, and academic achievement (Feder, Majnemer, & Synnes, 2000).

Improvements in a child's handwriting can be beneficial to social-emotional, early educational, and school career. Handwriting performance is often viewed as a reflection of the individual's capabilities affecting their self-image, attitude, behavior, and overall academic achievement (Feder et al., 2000). Writing creates the ability to distinguish each letter, which provides an avenue for learning about letters and sounds. Therefore, letter knowledge, ability to print, and attention to print is critical to early reading and literacy skills (Diamond, Gerde, & Powell, 2008). The ability to perform handwriting also affects a child's self-image, academic achievement, attitude, and behavior, which is often viewed as a reflection of an individual's capabilities (Feder et al., 2000). Overall, handwriting is a skill that is the building block for a student's ability to read, write, use language, and think critically (Handwriting Without Tears, 2015).

An estimated 20% of children in elementary schools experience difficulty acquiring necessary handwriting skills. This is problematic because 42% of children's time at school is spent on fine-motor activities, such as paper-and-pencil tasks (Schneck et al., 2012). Children struggling with handwriting often deplete their cognitive resources on the motor planning required for simple tasks, such as forming letters, rather than being able to utilize their skills for composition and written expression of an idea (Case-Smith, Weaver, & Holland, 2014). Due to the complexity of handwriting, impairments in the motor, sensory, or perceptual systems could lead to inefficient letter formation and functionally poor handwriting. However, many teachers are not trained on handwriting instruction, leading to difficulty addressing handwriting concerns in the classroom and prompting referrals to SBOT (Schneck et al., 2012).

Services provided by the OT may vary depending on the general education curriculum, the teacher's priorities, and the child's needs (Bazyx et al., 2009). In order for a child to be successful as a student, the team, including the SBOT and the general education teacher, must address difficulties in handwriting performance skills and analyze the demands of the activity (Donica, 2010). SBOT interventions address handwriting limitations for school-aged children because handwriting is a necessary skill for functioning in the mainstream classroom environment. When it is recognized that the student has greater needs, SBOTs are requested to assess the child for further intervention.

Within the school setting, SBOTs use assessments to aid in determining when treatment is necessary and to help guide intervention planning (Feder et al., 2000). Handwriting Without Tears screener is a standardized tool that uses a script for administration (Handwriting Without Tears, 2009a). This screener helps identify students who need additional support and track the development of critical handwriting skills (Handwriting Without Tears, 2009b). This tool

screens written capital letters, numbers, lower case letters, and sentence writing. The screener is used independently or as a part of a Response to Intervention (RtI) model to gather handwriting performance outcomes (Handwriting Without Tears, 2009a). Reports from classroom screeners provide percentages of students meeting or not meeting benchmarks; RtI Tier 1 achievement comparisons; and where to focus instruction and intervention (Handwriting Without Tears, 2009b).

Although there is literature to support that handwriting is the number one reason for referrals to SBOT's, researchers have found a lack of information that can guide SBOTs to determine when it is necessary to intervene early versus knowing that developmentally kindergarten students will gain these skills throughout the school year. Since there is a lack of consensus among handwriting data, the difficulty in skills related to handwriting has caused an abundance of children to be referred for occupational therapy (Hape Flood, McArthur, Sidara, Stephens, & Welsh, 2014). Through a retrospective analysis of the 2014-2015 school year, handwriting performance was assessed. Prompted by a clinical question, researchers were able to gather baseline data that will allow for SBOTs to know, based on the Handwriting Without Tears and copy screener data, when intervening is necessary.

Research Question

The purpose of this study was to guide teachers and SBOTs in recognizing handwriting needs and provide appropriate early intervention support for handwriting. The following research question guided the investigation: Are there correlations between the three measured aspects of Handwriting Without Tears screen categories of letter memory, line placement, and letter orientation, or additional copy legibility and copy placement skills that are predictive of handwriting ability in kindergarten students?

Method

Research design. This was a retrospective quantitative study designed to determine if errors in letter memory, line placement, letter orientation, copy legibility, and copy placement skills contribute to handwriting difficulties. Researchers analyzed variables measured during the fall, winter, and spring of the 2014-2015 school year. Handwriting screeners were administered to all kindergarten students in the Public School District. Baseline skills identified determined difficulty in handwriting skills versus the need for further instruction at the kindergarten level. Ethical approval was obtained from the Human Research Review Committee at Grand Valley State University.

Participants and setting. The population targeted by this study included general and special education kindergarten students who attended the Public School in the participating school district. Each kindergarten classroom had 20-28 students and the classroom teacher was present during the screening. All students on the class roster were given the Handwriting screeners. Students were excluded if they were absent on the day of the screen or if they had moved out of the district. Approximately 200 kindergarten students between the ages of 5.5-7 were given the handwriting screening. No participant recruitment was involved, a convenience sample of all students on the class roster in each kindergarten room were given the screener. The screener was administered as part of the natural school environment to collect data per State of Michigan curriculum guidelines.

Instruments. The Handwriting Without Tears screener helps identify students who need additional support and track the development of critical handwriting skills (Handwriting Without Tears, 2009b). The screener is a standardized tool that uses a script for administration (Handwriting Without Tears, 2009a). Face validity has been established because it was created

by a licensed occupational therapist. This tool screens written capital letters, numbers, lower case letters, and sentence writing. The screener is used independently or as a part of a RtI model to get handwriting performance outcomes (Handwriting Without Tears, 2009a). The Public School's copy screener was developed by the certified occupational therapists at the Public School. This screener was used to evaluate student legibility and line placement when copying from a near point sample. The screener was scored according to the student's ability to place words within 1/8 inch of the line and whether or not the letters were recognizable.

Data collection. Two occupational therapists and the certified occupational therapy assistant administered the Handwriting Without Tears Screener and a copy screener developed by the occupational therapists at the Public School. The Handwriting Without Tears Screener and the copy screener was put on an overhead projector and the administrator would read per the standard instructions for each section of the screen. The screener took an average of 15 minutes. No help was given to the students besides reminders about procedure and reorientation to which line they needed to be on via the overhead projector. After administration, the screeners were scored, converted to percentages, and de-identified before researchers received the data.

Data analysis: Data was analyzed using SAS Version 9.4 for Windows (SAS Institute Inc., Cary, NC). A proc-mixed procedure was completed to control for variability between classes. Researchers chose to use the statistical analysis of repeated measures because the students were measured more than one time throughout the school year. This analysis compared the difference between winter and spring percentages of all 218 students. The level of significance for testing was set at .05. The Handwriting Without Tears screener yields percentages to help identify specific skill areas where students are struggling.

Results

A sample of 218 kindergarten students participated in this study. The *p* values for four of the five winter variables were significant when compared to alpha level of .05. The *p* values for winter are less than .05 indicating a significant difference between students' scores when measured in the winter versus students' scores when measured in the spring. All line placement variables were unable to be predicted due to the fact that the estimate of zero implies that none of the variability for the spring score comes from the different classes when previous scores are used to explain variability.

Figure 1 shows the inconsistencies among the changes in score from fall to winter according to *p* values. Only two of the five *p* values calculated between fall and winter showed a significant effect. Figure 2 presents the significant outcomes of scores from winter to spring according to *p* values. The lower and upper confidence intervals illustrated in Figure 2 pinpoint parameters for the amount that students' spring scores may improve. From this information, there is a 95% confidence that for every increase of one percentage in the winter scores, the spring scores will go up between the upper and lower parameters identified.

Figure 1. Fall Statistics

Solution for Fixed Effects								
Effect	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**	**Alpha**	**Lower**	**Upper**
Fall Copy Legibility	0.02639	0.02833	141	0.93	0.3532	0.05	-0.02962	0.08239
Fall Letter Memory	0.05793	0.03119	145	1.86	0.0653	0.05	-0.00372	0.1196
Fall Line Placement	0.08403	0.02889	138	2.91	0.0042	0.05	0.02691	0.1412
Fall Copy Placement	0.08146	0.06597	142	1.23	0.2190	0.05	-0.04895	0.2119
Fall Letter Orientation	0.005120	0.01960	139	0.26	0.7943	0.05	-0.03363	0.04387

* $p < .05$.

Figure 2. Winter Statistics

Solution for Fixed Effects								
Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Winter Copy Legibility	0.1742	0.06475	157	2.69	0.0079	0.05	0.04633	0.3021
Winter Letter Memory	0.5874	0.05900	161	9.96	<.0001	0.05	0.4709	0.7039
Winter Line Placement	0.5537	0.05976	155	9.27	<.0001	0.05	0.4357	0.6718
Winter Copy Placement	0.3303	0.06658	157	4.96	<.0001	0.05	0.1988	0.4619
Winter Letter Orientation	0.8116	0.05951	156	13.64	<.0001	0.05	0.6941	0.9292

* $p < .05$.

Discussion

This study compared fall, winter, and spring writing samples from kindergarten students measured by the Handwriting Without Tears' screener and the Public School's copy task. When comparing these three samples, researchers looked at copy legibility, letter memory, copy placement, line placement, and letter orientation. Results indicate that winter scores are more predictive of spring scores than those obtained during the fall. The majority of fall scores were not consistently predictive of winter and spring scores. The results of this study can help SBOTs, as well as educators, in identifying when it may be necessary to provide intervention for handwriting needs. The outcomes indicate that SBOTs should intervene after results are obtained from the winter screens. Researchers found that the Handwriting Without Tears screens and the Public School copy task can identify significant changes in handwriting performance.

Limitations and Directions for Further Research

The major limitations of this study was that on average there were 30 children absent on screening days or moving out of the school district. Additionally, the use of only one geographic region limits the ability to generalize the results of this research. Next, a convenience sample from only one school district was used; the participants did not effectively represent a heterogeneous population of kindergarten students, as a random sample would have. Also, there was a lack of blinding to students samples until data was de-identified by the Public School occupational therapist. Finally, this research was limited based on validity and reliability, which are not statistically established for the Handwriting Without Tears screener or the Public School's screener.

Implications for Occupational Therapy Practice

Intervening during early childhood is critical in children's handwriting development; it is related to early literacy skills such as letter knowledge (Gerde, Foster, & Skibbe, 2014), which is supported by the current study. SBOT's should consider the following implications of this study:

- During a kindergarten school year, screening tools can be used to identify intervention needs.
- Information cannot be gained from fall scores to indicate a student's need for handwriting intervention.
- Intervention needs are better recognized following winter screens because there was minimal change between fall and winter screening scores.

Conclusion

A comparison of retrospective data determined that there were significant changes among handwriting data. Winter scores were shown to be significant in determining handwriting

outcomes measured in the spring. This study recognizes that SBOTs can best determine intervention needs after the winter screen. The Handwriting Without Tears screener along with the screener created by the Public School occupational therapist are appropriate tools for SBOTs to use to identify when intervention is needed.

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