

Handwriting Intervention Primer

Evidence-based Informational Charts for Occupational Therapists Treating Children with Handwriting Difficulties



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In a 2016 column, Jean E. Polichino, an occupational therapy administrator, recalls her first days working in the public schools in Houston. Polichino laments:

As I confronted the expectations of campus personnel and district special education administrators that school year, most perplexing was the assumption that I possessed expertise to evaluate and intervene for handwriting difficulties for students with disabilities. Evaluation and intervention for fine-motor skill development and loss of fine-motor function had been covered in my occupational therapy (OT) coursework, but handwriting remediation was definitely *not* included in my OT preparation.... Nevertheless, I quickly learned that it was part of the service I was expected to provide as an OT for children unable to meet the time and legibility standards of writing.

Although specific handwriting remediation may, or may not be a part of occupational therapy curriculums, occupational therapists are often called upon to treat emerging and persistent handwriting difficulties. In fact, handwriting difficulties are reportedly the most common reason school-aged children are referred to occupational therapy (Schneck and Amundson, 2010) and account for more than 40% of the referrals received by school-based occupational therapists (Roston, 2010).

What advances occupational therapy practitioner's position for providing handwriting intervention is a combination of specific and unique skills including our expertise in child development and motor learning theory, and our capacity for analyzing meaningful occupations and recognizing underlying performance skill deficits that impact handwriting. The

fundamental knowledge and skillset are already well established; but being familiar with the current evidence-based handwriting research further allows us to focus on interventions with proven efficacy.

The following charts have been developed as a primer for occupational therapy practitioners who work with children with handwriting difficulties. The first chart, *General Dos and Don'ts*, provides universal strategies for handwriting instruction and intervention that is evidence-based. The second chart, *Specific Handwriting Interventions*, reviews individual factors that impact handwriting and are commonly addressed by occupational therapy practitioners. The chart provides descriptions of how handwriting may be manifested when impacted by each factor and provides suggestions for treatment strategies and supports for remediation.

General Dos and Don'ts

Do	Do Not
<ul style="list-style-type: none">• Individualize instruction based on student's needs• Provide explicit handwriting instructions on letter formation that include:<ul style="list-style-type: none">• Each letter's starting point• Stroke direction• Model letter formation• Provide simple and consistent verbal and visual cues and instructions• Introduce letters with easy stroke sequence before progressing to more difficult stroke sequences• Teach only 1-2 letters at a time• Provide abundant opportunities to practice handwriting including tracing and copying• Provide opportunities to practice from memory• Encourage goal-setting and self-evaluation• Provide positive corrective feedback• Collaborate with teachers and involve parents/caregivers	<ul style="list-style-type: none">• Exclusively address underlying components of handwriting such as:<ul style="list-style-type: none">• Motor skills• Visual-motor integration• Visual perception• Kinesthesia• In-hand manipulation• Biomechanical aspects of handwriting (grasp, positioning)• Overemphasize neatness• Overemphasize speed

Keep in Mind...

Although handwriting is often evaluated on legibility and speed, neither of these handwriting measures should be overemphasized during the early stages of instruction of intervention. Focus on proper letter formation. Neatness and speed often follow as the skill becomes automatic.

Keep in mind...

- As children grow, they develop motor control in the distal areas of the wrist and hand which enable smaller movements and allow children to draw smaller letters (Rosenblum, 2018). Writing large letters is appropriate for young writers.
- Even with proficient handwriting, there is a “negative relation between handwriting speed and handwriting quality...indicating that fast handwriting is detrimental to handwriting quality” (Gosse, Parmentier, & Van Reybroeck 2021, p. 1). Developing handwriters should be encouraged to focus on consistent letter formation and discouraged from writing fast.
- The conscious attention to neatness negatively impacts the production of automated handwriting movements (Tucha & Lange, 2005). *Ultimately, the purpose of handwriting instruction is to help children develop a handwriting style that is “legible and fluent enough” so that the child’s attention can focus on the content of a writing task rather than the physical act of writing* (Graham, 2018, p. 1370).

Specific Handwriting Strategies

Factors Impacting Handwriting	Handwriting Characteristics	Strategies and Supports
<p><u>Motor Planning</u> reflects the process of selecting a specific movement pattern from an infinite number of possible movement patterns in order to achieve a desired goal.</p>	<ul style="list-style-type: none"> • Letter formation errors (incorrect start position, strokes formed in the wrong direction, missing strokes) • Inconsistent letter size • Macrographia (large letter size) • Variable stroke trajectory • Poor alignment • Tendency to pause for a greater percentage of the writing task 	<ul style="list-style-type: none"> ⇒ Offer more opportunities to practice letter formation. ⇒ Be consistent and repetitive with instruction language. ⇒ Provide visual cues (e.g. lined paper, directional arrows for letter segment trajectory) ⇒ Encourage students to edit work ⇒ Practice tracing and copying letters ⇒ Practice dot-to dot tracing ⇒ Fade prompts ⇒ Video self-modeling*
<p><u>Fine Motor Coordination</u> hand skills include grasping, carrying and releasing, reaching, and in-hand manipulation</p>	<ul style="list-style-type: none"> • Macrographia (large letter size) • Poor alignment • Impaired legibility • Slow pace • Frequent erasures • Immature grasp 	<ul style="list-style-type: none"> ⇒ Offer more opportunities to practice letter formation. ⇒ Provide visual cues (e.g. lined paper) ⇒ Practice tracing and copying letters ⇒ Practice dot-to dot tracing ⇒ Offer opportunities for drawing and coloring to improve in-hand manipulation skills and strengthen intrinsic hand muscles
<p><u>Kinesthesia/ Proprioception</u> abilities relay information about hand position and information about the amplitude and direction of</p>	<ul style="list-style-type: none"> • Letter formation errors (strokes formed in the wrong direction, letter inversions) • Tendency to pause for a greater percentage of the writing task • Difficulty writing in boundaries 	<ul style="list-style-type: none"> ⇒ Offer more opportunities to practice letter formation. ⇒ Provide visual cues (e.g. lined paper, directional arrows for letter segment trajectory) ⇒ Encourage visual monitoring of letter formation

<p>movements without visual or auditory cues.</p>	<ul style="list-style-type: none"> • Influences amount of pressure applied to writing utensil and writing surface • Fatigue 	<p>⇒ Trial various writing utensils (e.g., pencils with different graphite hardness**, ink pens, markers) that may offer feedback regarding the amount of pressure that is being applied</p>
<p><u>Visual Motor Integration</u> is the ability to guide movements by means of visual sensory information.</p>	<ul style="list-style-type: none"> • Poor alignment • Slow handwriting • Difficulty copying 	<p>⇒ Offer more opportunities to practice letter formation</p> <p>⇒ Provide lined paper</p> <p>⇒ Encourage students to edit work</p> <p>⇒ Tracing and copying</p> <p>⇒ Dot-to dot tracing</p> <p>⇒ Fade prompts (e.g., directional arrows for stroke direction)</p>
<p><u>Biomechanical Ergonomic</u> factors: body posture and pencil grasp</p>	<ul style="list-style-type: none"> • Hand fatigue and stiffness with handwriting • Impaired legibility • Hand cramping • Fatigue (general) 	<p>⇒ Trial a cutout worksurface or desk with 20 degree incline for hemiplegic children.</p> <p>⇒ For children with atypical muscle tone, provide seating that is comfortable and supports upper trunk and arm.</p> <p>⇒ Encourage comfortable and controllable pencil grasp (mature grasp if possible).</p> <p>⇒ Trial various writing utensils (e.g., pencils with different graphite hardness**, gel ink pens, markers) that require less grip force</p>
<p><u>Attention</u> – sustaining attention over certain period of time and maintaining an intention for selection against distractions.</p>	<ul style="list-style-type: none"> • Frequent omissions of letters • Frequent erasures • Poor alignment • Poor rhythm (increased pausing) 	<p>⇒ Offer more opportunities to practice letter formation.</p> <p>⇒ Allow additional child-centered interest-driven environmental stimulation (e.g., background music, fidget)</p> <p>⇒ Avoid monotonous practice</p> <p>⇒ Encourage students to edit work</p>

		<ul style="list-style-type: none"> ⇒ Color stimulation* <ul style="list-style-type: none"> ○ Allow students to choose lined colored paper. ⇒ Concentrative coordination exercises**
<p><u>Executive Function</u> is an “umbrella term that encompasses high-level cognitive functions such as planning and organization, reasoning, and problem solving, conceptual thought, self-correction, judgement, and decision making” (Rosenblum, 2013, p 357).</p>	<ul style="list-style-type: none"> • Difficulty with letter formation and layout on the page • Alterations including crossing out text, adding strokes, and retracing letters to correct form • Poor organization of text within the space available • Inconsistent spacing within and between words • Poor alignment 	<ul style="list-style-type: none"> ⇒ Offer more opportunities to practice letter formation. ⇒ Be consistent and repetitive with instruction language. ⇒ Provide lined paper ⇒ Encourage students to edit work ⇒ Allow more time to produce text

*** Video Self-modeling**

Harris, et. al., (2017), examined video self-modeling (VSM) as a treatment for improving handwriting legibility and fluidity in autistic children. For this study, the researchers video-taped autistic children writing their name, the word ‘cat,’ and the word ‘apple,’ on three separate lines. The video was edited to show the participant writing “smoothly and correctly” (p. 161). These video tapes were then shown to the participant at the beginning of the treatment session. After viewing the video, the participant was asked to rewrite their name, ‘cat,’ and ‘apple.’ The researchers found that the VSM was effective for improving and maintaining handwriting legibility in autistic students. This study is limited by a small sample size (3) and limited scope (writing only three words). More research is needed to improve confidence in this type of intervention.

****Pencil Hardness**

Pencil leads are made up of graphite and clay. The hardness of the lead varies with the ratio of the mixture (more clay contributes to a harder lead; more graphite makes it softer). Lead hardness is graded and commonly indicated on the pencil. Softer lead produces a darker product (line drawn on the paper). The tip of softer leads also erodes quicker with

use than harder leads and requires more frequent sharpening. Conversely, harder leads hold their point longer with use, produce a lighter pencil mark, and may break more easily than softer leads. Because softer leads produce a darker product, they may require less grip/pinch pressure to use.

*** *Color Stimulation*

Imhof, (2014), investigated the use of colored paper on handwriting performance in children with ADHD. Imhof found that when children with ADHD use lined colored paper (specific color was chosen by the student), the legibility of their handwriting improved. Handwriting improvements were attributed to the addition of “external stimulation facilitating behavioral inhibition and regulation of selective attention and graphomotor coordination” (p.191). The explanation for this improvement was based on the assumption “that changes in the cortical activation, which are elicited by the color stimulation, have an influence on behavioral inhibition and facilitate motor coordination, attention regulation, and the effective monitoring of cognitive functions, such as working memory and motivational regulation” (p.192).

**** *Concentrative Coordination Exercises*

Chang et. al., (2022), examined if the concentration on visual information required for motor coordination training (i.e., playing table tennis), would improve executive function and graphomotor performance for children with ADHD. The authors found that handwriting outcomes improved after the subjects participated in table tennis training. The authors surmised that table tennis training involves “continuous successive hits” and “long-duration tasks that require concentration and focus over time” which positively impacted “graphomotor automation and quicker response times for handwriting and copying” (p. 1026). More research is needed to strengthen confidence with this type of intervention. It is important to note that the vast majority of research on handwriting interventions recommends the therapeutic practice of handwriting.

[For more information...](#)

- Barnett, A. L., & Prunty, M. (2021). Handwriting difficulties in developmental coordination disorder (DCD). *Current Developmental Disorders Reports*, 8(1), 6-14. <https://doi.org/10.1007/s40474-020-00216-8>
- Batchelder, A., McLaughlin, T. F., Weber, K. P., Derby, K. M., & Gow, T. (2009). The effects of hand-over-hand and a dot-to-dot tracing procedure on teaching an autistic student to write his name. *Journal of Developmental and Physical Disabilities*, 21(2), 131–138. <https://doi.org/10.1007/s10882-009-9131-2>
- Case-Smith, J., Weaver, L., & Holland, T. (2014). Effects of a classroom-embedded occupational therapist–teacher handwriting program for first-grade students. *American Journal of Occupational Therapy*, 68(6), 690-698. <https://doi.org/10.5014/ajot.2014.01158>
- Chang, S. H., Shie, J. J., & Yu, N. Y. (2022). Enhancing Executive Functions and Handwriting with a Concentrative Coordination Exercise in Children with ADHD: A Randomized Clinical Trial. *Perceptual and Motor Skills*, 00315125221098324 <https://doi.org/10.1177/00315125221098324>
- Cohen, R., Cohen-Kroitoru, B., Halevy, A., Aharoni, S., Aizenberg, I., & Shuper, A. (2019). Handwriting in children with Attention Deficient Hyperactive Disorder: role of graphology. *BMC Pediatrics*, 19(1), 1-6. <https://doi.org/10.1186/s12887-019-1854-3>
- DuBois, L., Klemm, A., Murchland, S., & Ozols, A. (2004). Handwriting of children who have hemiplegia: a profile of

5 abilities in children aged 8–13 years from a parent and teacher survey. *Australian Occupational Therapy Journal*, 51(2), 89-98. <https://doi.org/10.1111/j.1440-1630.2004.00436.x>

Farris, K. M., Fehrenbacher, R. E., Hayes, E. L., McEvoy, R. R., Smith, A. P., & McCulloch, R. S. (2021). The relationship between muscle activation and handwriting quality with non-native grip styles. *Journal of Hand Therapy*. <https://doi.org/10.1016/j.jht.2021.03.004>

Feder, K. P., & Majnemer, A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine & Child Neurology*, 49(4), 312-317. <https://doi.org/10.1111/j.1469-8749.2007.00312.x>

Fogel, Y., & Rosenblum, S. (2022). Anticipatory Awareness and actual handwriting performance measures among adolescents with deficient executive functions. *Children*, 9(11), 1628. <https://doi.org/10.3390/children9111628>

Godde, A., Tsao, R., Gepner, B., & Tardif, C. (2018). Characteristics of handwriting quality and speed in adults with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 46, 19-28. <https://doi.org/10.1016/j.rasd.2017.11.005>

Gosse, C., Parmentier, M., & Van Reybroeck, M. (2021). How do spelling, handwriting speed, and handwriting quality develop during primary school? Cross-classified growth curve analysis of children's writing development. *Frontiers in psychology*, 12, 685681. <https://doi.org/10.3389/fpsyg.2021.685681>

Graham, S. (2018). Handwriting instruction: a commentary on five studies. *Reading and Writing*, 31(6), 1367-1377. <https://doi.org/10.1007/s11145-018-9854-5>

- Grajo, L. C., Candler, C., & Sarafian, A. (2020). Interventions within the scope of occupational therapy to improve children's academic participation: a systematic review. *The American Journal of Occupational Therapy*, 74(2), 7402180030p1-7402180030p32. <https://doi.org/10.5014/ajot.2020.039016>
- Harris, G. M., Little, S. G., & Akin-Little, A. (2017). Video self-modelling as an intervention for remediating dysgraphia in children with autism spectrum disorders. *Australian Journal of Learning Difficulties*, 22(2), 153-170. <https://doi.org/10.1080/19404158.2017.1397525>
- Imhof, M. (2004). Effects of color stimulation on handwriting performance of children with ADHD without and with additional learning disabilities. *European Child & Adolescent Psychiatry*, 13(3), 191-198. <https://doi.org/10.1007/s00787-004-0371-5>
- Johnson, B. P., Phillips, J. G., Papadopoulos, N., Fielding, J., Tonge, B., & Rinehart, N. J. (2015). Do children with autism and Asperger's disorder have difficulty controlling handwriting size? A kinematic evaluation. *Research in Autism Spectrum Disorders*, 11, 20-26. <https://doi.org/10.1016/j.rasd.2014.11.001>
- Kavak, S. T., & Bumin, G. (2009). The effects of pencil grip posture and different desk designs on handwriting performance in children with hemiplegic cerebral palsy. *Jornal de Pediatria*, 85, 346-352. <https://doi.org/10.2223/JPED.1914>
- Lin, Y. C., Chao, Y. L., Wu, S. K., Lin, H. H., Hsu, C. H., Hsu, H. M., & Kuo, L. C. (2017). Comprehension of handwriting

development: Pen-grip kinetics in handwriting tasks and its relation to fine motor skills among school-age children. *Australian Occupational Therapy Journal*, 64(5), 369-380. doi: 10.1111/1440-1630.12393

McNamee, T., & Patton, S. (2018). Teachers' perspectives on handwriting and collaborative intervention for children with Autistic Spectrum Disorder. *Irish Journal of Occupational Therapy*. <https://doi.org/10.1108/IJOT-12-2017-0026>

Palmis, S., Danna, J., Velay, J. L., & Longcamp, M. (2017). Motor control of handwriting in the developing brain: A review. *Cognitive Neuropsychology*, 34(3-4), 187-204. <https://doi.org/10.1080/02643294.2017.1367654>

Pfeiffer, B., Moskowitz, B., Paoletti, A., Brusilovskiy E, Zylstra, S., & Murray, T. (2015). Developmental test of Visual Motor Integration (VMI): an effective outcome measure for handwriting interventions for kindergarten, first-grade, and second-grade students? *American Journal of Occupational Therapy*, 69(4), 6904350010p1-6904350010p7. <https://doi.org/10.5014/ajot.2015.015826>

Polichino, J. E. (2016). Ponderings of an occupational therapy administrator: Beyond handwriting—Are we ready?. *Journal of Occupational Therapy, Schools, & Early Intervention*, 9(1), 2-5. <https://doi.org/10.1080/19411243.2016.1153870>

Prunty, M., & Barnett, A. L. (2017). Understanding handwriting difficulties: A comparison of children with and without motor impairment. *Cognitive neuropsychology*, 34(3-4), 205-218 <https://doi.org/10.1080/02643294.2017.1376630>

Prunty, M., & Barnett, A. L. (2020). Accuracy and consistency of letter formation in children with developmental coordination disorder. *Journal of Learning Disabilities*, 53(2), 120-130. <https://doi.org/10.1177/00222194198928>

- Rosenblum, S. (2013). Handwriting measures as reflectors of executive functions among adults with Developmental Coordination Disorders (DCD). *Frontiers in Psychology, 4*, 357. doi:10.3389/fpsyg.2013.00357
- Rosenblum, S. (2018). Inter-relationships between objective handwriting features and executive control among children with developmental dysgraphia. *PloS one, 13*(4), e0196098. <https://doi.org/10.1371/journal.pone.0196098>
- Rosenblum, S., Goldstand, S., & Parush, S. (2006). Relationships among biomechanical ergonomic factors, handwriting product quality, handwriting efficiency, and computerized handwriting process measures in children with and without handwriting difficulties. *The American Journal of Occupational Therapy, 60*(1), 28-39. <https://doi.org/10.5014/ajot.60.1.28>
- Rosenbaum, D. A., Meulenbroek, R. G., & Vaughan, J. (2004). What is the point of motor planning?. *International Journal of Sport and Exercise Psychology, 2*(4), 439-469. <http://hdl.handle.net/2066/64371>
- Rosenblum, S., Simhon, H. A. B., & Gal, E. (2016). Unique handwriting performance characteristics of children with high-functioning autism spectrum disorder. *Research in Autism Spectrum Disorders, 23*, 235-244. <https://doi.org/10.1016/j.rasd.2015.11.004>
- Roston, K. (2010). A frame of reference for the development of handwriting skills. In Kramer, P. & Hinojosa, J. (Ed.), *Frames of reference for pediatric occupational therapy* (3rd ed., pp. 425- 460). Lippincott Williams & Wilkins.
- Schneck, C.M. & Amundson, S. J. (2010). Prewriting and Handwriting Skills. In Case-Smith, 6th Edn., J. & O'Brien, J. C. (Eds.), *Occupational Therapy for Children* (pp:555-582). St. Louis, MO.: Mosby/Elsevier,

ISBN-13: 9780323056588.

Smith, E., McLaughlin, T. F., Neyman, J., & Rinaldi, L. (2013). The effects of, lined paper, prompting, tracing, rewards, and fading to increase handwriting performance and legibility with two preschool special education students diagnosed with developmental delays, and fine motor deficits. *Journal on Educational Psychology*, 6(4), 23-29.

Tucha, O., & Lange, K. W. (2005). The effect of conscious control on handwriting in children with attention deficit hyperactivity disorder. *Journal of Attention Disorders*, 9(1), 323-332. <https://doi.org/10.1177/108705470527999>