Teaching Handwriting to Students with Autism

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Why teach handwriting?

- Proficient handwriting is predicative of length and quality of written expression (Baker, Gersten, & Graham, 2003)
- Composition length and complexity improves with fluent handwriting (Baker, Gersten, & Graham, 2003; Edwards, 2003)
- Handwriting can increase independence in tasks of daily living (e.g. making a shopping list, writing a note, signing a check, filling out a job application form, etc.)
- Poor handwriting can be stigmatizing (Feder & Majnemer, 2007)
Stages of Handwriting

- Imitation
  - Do what I do
- Copying
  - Write what I show you
- Transcription / dictation
  - Write what I tell you
- Composition

Handwriting in Learners with Autism

Children with autism show specific handwriting impairments

**ABSTRACT**

**Backgrounds:** Handwriting skills, which are crucial for success in school, communication, and building children’s self-esteem, have been observed to be poor in individuals with autism. Little information exists on the handwriting of children with autism, without delineation of specific features that can contribute to impairments. As a result, the specific aspects of handwriting in which individuals with autism demonstrate difficulty remain unknown.

**Methods:** A case-control study of handwriting samples from children with and without autism spectrum disorders (ASD) was performed using the Minnesota Handwriting Assessment. Samples were scored on an individual letter basis in 5 categories: legibility, form, alignment, size, and spacing. Subjects were also tested on the Wechsler Intelligence Scale for Children-IV and the Physical and Neurological Examination for Subtle Motor Signs.

**Results:** We found that children with ASD do indeed show overall worse performance on a handwriting task than do age- and intelligence-matched controls. More specifically, children with ASD show worse quality of forming letters but do not show differences in their ability to correctly size, align, and space their letters. Within the ASD group, motor skills were significantly predictive of handwriting performance, whereas age, gender, IQ, and visuospatial abilities were not.
Handwriting in Learners with ASD

- When compared to their typically developing peers, children with autism displayed less precise letter formation (Fuentes, Mostofsky & Bastian, 2009).

Examples of Common Form Errors

- Sharp points in sections that should be curved
- Extensions (cross-hatching)
- General formation errors

(Fuentes, Mostofsky & Bastian, 2009)
Skills that Affect Handwriting

- Visual perception
- Visual-motor integration
- Postural stability
- In-hand manipulation
- Grasp
- Hand strength
- Memory
- Attention
- Fluency

What to Teach

- The two most important elements of handwriting are legibility & speed (Feder & Majnemer, 2007)
  - Letter formation, spacing, size, slant, and alignment can all affect legibility
Pre-Requisites for Writing

- Hand dominance
- Crossing midline
- Bilateral hand use
- Functional grasp
- Pushing hard enough on a writing utensil to produce a mark
- Imitation with objects
- Imitation of drawing lines & simple figures
- Visually discriminating between similar figures

Role of Proximal Stability in Handwriting

Analysis of Proximal and Distal Muscle Activity During Handwriting Tasks

Shoshana Naider-Stentrup, Michal Katz-Leurer

**Key Words:**
- electromyography
- handwriting
- Jewish
- muscle activity
- pediatrics

**Objective:** In this study we sought to describe upper extremity proximal and distal muscle activity in typically developing children during a handwriting task and to explore the relationship between muscle activity and speed and quality of writing.

**Method:** We evaluated 25 third- and fourth-grade children using the Action Video Tachistoscopic Task. Simultaneously, we recorded participants' upper arm and hand muscle activity by surface electromyography. Using the coefficient of variation (standard deviation divided by mean amplitude) as a measure of variability within each muscle, we analyzed differences in muscle activity variability within and between muscles.

**Results:** The proximal muscles displayed significantly less variability than the distal muscles. Decreased variability in proximal muscle activity was associated with increased variability in distal muscle activity, and increased variability in the distal muscles was significantly associated with faster speed of writing.

**Conclusion:** The lower amount of variability exhibited in the proximal muscles compared with the distal muscles seems to indicate that the proximal muscle function is critical during a handwriting task. In addition, increased variability in both proximal and distal muscle activity appears to be more economical and is related to faster writing speed. Knowledge of the type of proximal and distal muscle activity used during handwriting can help occupational therapists plan intervention for children with handwriting disabilities.

Grasp & Writing

- A functional grasp allows the necessary fine movements needed to write
- An atypical grip does not necessarily mean that a child will have handwriting problems

Developmental Grasp Variations

Child Development, August 1998, Volume 69, Number 4, Pages 888-902

Using Writing Instruments: Invariances in Young Children and Adults

Tammy Gross and Jeffrey J. Lockman

In 2 studies, developmental changes in variability associated with handwriting were investigated. In Study 1, variability in grip patterns and pen positioning relative to a flat surface were examined in 3- and 5-year-olds and adults. The results indicated that between 3 and 5 years of age there is a reduction in the number of grips that individual children routinely use and a reduction in variability associated with pen-surface positioning. In Study 2, the 5-year-old children who participated in Study 1 were tested 6 months later. In comparison to young 3-year-old children, older 3-year-olds use an adult grip pattern more often and are less variable in pen-surface positioning, although the use of multiple grip patterns is still common. The findings from both studies are considered in relation to prior research that emphasized modal patterns of motor development and newer work that uses developmental changes in variability to understand the acquisition of motor skill.
Writing Grasp Research

- The American Journal of Occupational Therapy published research on the writing forces associated with four pencil grasp patterns in 74 children in grade 4.
- The students completed a handwriting assessment before and after a copy task and grip and axial forces were measured.
Grip forces were generally similar across the different grasps, although adducted thumb grasps exhibited higher mean grip and axial forces.

Grasp did not have a significant impact on legibility or speed

Conclusion: focus more on speed and letter formation than on grasp patterns
Dysfunctional Writing Grasps

- Thumb tuck
- Digital pronate
- Palmar supinate
- Radial cross palmar

Thumb tuck

- The pencil may be held with a tripod or quadrood grasp
- The thumb wraps around the pencil and is tucked into the web-space
Digital Pronate

• The pencil is held within the hand, not the web space
• Movement comes primarily from the forearm/shoulder

Palmar Supinate

• The pencil is tucked into the fist
• Fist is turned in a “thumbs up” position
Radial Cross Palmar

• Pencil is tucked into fist
• Fist is turned, “thumbs down”

Shaping a Functional Grasp

• Yakimishyn and Magill-Evans (2002) found that students used a more mature pencil grasp for writing when provided with a short writing tool and a vertical writing surface.
Functional Grasp Activities

- Color with short, stubby crayons
- Use a short, stubby stylus on an iPad
- Lite Brite

Grasp Activities with Timocco
Wrist Extension Activities

• Drawing on an easel, chalkboard, or thick binder
• Coloring underneath a table
• Window clings or window markers on a window

Posture

• The body must be stable to support distal mobility
• Investigate the height of the chair & writing surface
• Hips, knees, ankles should be at 90-120 degrees
• Forearm should be stabilized on writing surface
• Wrist should be extended
  (Feder & Majnemer, 2007)
Hand Strength

Adaptive Equipment to Shape Grasp

• A variety of pencil grips can be made or purchased to promote a functional grasp and separate the radial fingers used in writing (thumb, index, middle) from the ulnar side of the hand (ring finger, pinky)

• If adaptive equipment is introduced, there should be a systematic plan for fading
Ellie Grip

- Made from a sock, with openings only for index finger and thumb
- Red for right hand, blue for left hand

The Writing CLAW

- Latex-free rubber
- Fits left or right hand
- Thumb, index and middle finger slide into separate places
HandiWriter

- The HandiWriter® is worn with the large loop around the wrist. The charm is held in the palm of the hand with the pinky and ring fingers.
- The thumb, first and middle fingers grasp a pencil and the top loop of the HandiWriter® is placed around the top of the pencil.

Significance of Drawing

- Children are often required to draw as part of reading, writing, or art projects
- Drawing may also be used as a strategy for solving math problems
- Later in life, drawing may function as an instrumental ADL (drawing a map, making a diagram, etc)
Developmental Sequence of Drawing Skills

• Vertical line
• Horizontal line
• Circle
• Cross +
• Square
• Triangle
• Complex representational drawing

Teaching Drawing Skills

• Teach the following “types” of drawing
  – Imitation
  – Copying
  – Dictation
• Use a “clean slate” every time
• Most learners will require physical prompting, at least at first
Teaching Drawing Skills

- If physical prompts alone are ineffective, consider the use of within-stimulus prompts
  - Tracing
  - “Dot” prompts
  - Color-coded prompts
  - Verbal prompts

Copying a Circle

- Mastered around 36-40 months
- End points must overlap, 1” or less
- Consider use of “dot prompt” during teaching
- Some children may need to be taught circular scribble as a pre-step
Copying Lines

- Teach vertical: top to bottom
- Teach horizontal: left to right
- Emphasize matching length of modeled line
- For children who tend to scribble, it may be helpful to model putting the writing utensil down

Copying Cross

- Teach after vertical line & horizontal line are mastered
- Intersperse vertical & horizontal line
- Can prompt DOR
- Can use color-coded within-stimulus prompts
Copying Square

- Emphasize stopping at the corners
  - May need to pick marker up at first
- Dot prompts
- Verbal prompts
- Backwards chaining

Direct Instruction

The Effects of Fading, Modeling, Prompting, and Direct Instruction on Letter Legibility for Two Preschool Students with Physical and Developmental Delays

Christine Park
Kimberly P. Weber
T. F. McLaughlin

ABSTRACT. The purpose of this study was to determine the effectiveness of the model, lead, and test procedure, as well as a fading procedure with prompts and Direct Instruction with two preschool developmentally delayed students. These procedures were implemented to teach a class of preschoolers to write their names in preparation for their kindergarten transition. The participants were enrolled in a special education preschool and both were referred to the program due to physical as well as academic delays. Signing their name was a daily task that the students needed to accomplish before they started the day. During baseline both students had difficulty with letter identification and formation. The results of the model, lead and test suggested that these were effective procedures.
Basics of Direct Instruction

- Model
- Lead (prompt)
- Test (transfer trial)

Basics of Direct Instruction

Teacher: “Write A”
Learner: writes A with physical prompting
Teacher: “Make an A”
Learner: imitates writing A independently
Teacher: intersperses high probability responses, then returns to original demand “Make an A like mine”
Learner: imitates writing A independently

Evidence-Based Strategies

- Blocked practice is important for formation and automaticity (Poole, 1991; Christensen, 2005)
- Randomized practice produces better retention and generalization (Ste-Marie, Clark, Findlay, & Latimer, 2004)
- Include functional tasks (Denton, Cope & Moser, 2006)
- Use a variety of materials (Denton, Cope & Moser, 2006)
- Utilize visual and verbal prompts to teach letter formation (Graham & Weintraub, 1996)
- For students with autism, targeting formation and fine control yields the most significant results (Fuentes, Mostofsky, & Bastian, 2009)
- Utilize chaining & video modeling (Moore et al., 2013)
The evidence suggests we should not...

- Focus on visual motor integration, sensorimotor function, or fine motor control in isolation and expect generalization to handwriting (Denton, Cope & Moser, 2006; Schwellnus et al., 2012)
- Wait for children to “grow out” of handwriting deficits (Feder & Majnamer, 2007)
Video Modeling

- Create your own videos
- Purchase videos such as The TV Teacher
- Apps that incorporate video modeling
Handwriting Apps

• There are a variety of handwriting apps available that teach components of handwriting
• There is research suggesting that self-directed practice can boost handwriting acquisition (Robin, Armel & O’Leary, 1975)
• Although the effects of handwriting apps have not been formally studied, many of them are based upon teaching concepts drawn from the literature and correspond with common handwriting curricula
• May be helpful for parents to use outside of school/therapy
  – Consider Guided Access function on the iPad/iPhone

Handwriting Apps

• iWrite Words
• Letter School
• Handwriting Without Tears
• Start Dot Handwriting
Handwriting Curricula

• Most children require a systematic curriculum in order to learn writing skills
• A variety of curricula are commercially available, including
  – The Sensible Pencil
  – Handwriting Without Tears
  – Zaner-Bloser
  – D’ Nealian
  – Size Matters Handwriting Program
• The literature does not suggest that one particular program is superior (Asher, 2006).

Handwriting Without Tears

• Developed by Jan Olsen, an occupational therapist
• Emphasis on following developmental sequences for learning letters (diagonals come last)
• Modified teaching strategies are likely warranted for our learners with developmental disabilities such as autism
• This program is commonly utilized in special education settings.
Teaching Sequence

• HWT recommends teaching capital letters before lowercase letters
• HWT groups letters by formation patterns
  — Frog jump: F E D P B R N M
  — Starting corner: H K L U V W X Y Z
  — Center starters: C O Q G S A I T J

Adapted Sequence

• Straight line: F L E H T I
• Curved: D P B C O G U J S
• Diagonal: R N M Q A K V W X Y Z
General Steps to Mastery

• Steps to omit, given the literature: non-writing tasks
• Imitate on slate
• Copy on slate
• Copy in blocks on paper
  – For children who struggle with this step, consider adding more steps between slate/blocks
• Copy between lines
  – Pros / Cons of HWT paper
• Writing dictated letters between lines
• Copy between smaller lines

Writing Name

• Developmentally, most neurotypical children write their names in all capitals before using appropriate capitalization
  – Pros
  – Cons
• It is usually beneficial to teach learners with special needs to print their first name with appropriate capitalization from the start
Lowercase Letters

- HWT teaches in this order:
  - Look-a-likes: c o s v w t
    • Adaptation = teach x and z before t
  - Magic c: a d g
  - Remaining vowels: u i e
  - Transitions: l k y j
  - Dive down: p r n m h b
  - Final letters: f q x z

Capital & Lowercase Letter Sequences

- It is customary across many curricula to teach capital letters before lowercase letters.
- Why?
  • Is this the best choice for all of our learners?
Writing Name

• Developmentally, most neurotypical children write their names in all capitals before using appropriate capitalization
  – Pros
  – Cons
• It is usually beneficial to teach learners with special needs to print their first name with appropriate capitalization from the start

Writing Name

• Can be taught via forward or backward chaining
• For some learners, it is helpful to teach them to spell their names by signing or speaking, although this is not a pre-requisite to writing their name
Within-Stimulus Prompt

Paper Used for Handwriting

• Children in elementary grades are provided large-spaced paper for writing to allow for greater freedom of hand movement and to decrease eye strain (Waggoner, LaNunziata, Hill, & Cooper, 1981).
• Several studies found that use of large-spaced paper improved the letter strokes of some groups of elementary school students but not others (Hill, Gladden, Porter, & Cooper, 1982; Trapp-Porter, Gladden, Hill, & Cooper, 1983)
• Daly, Kelley, and Krauss (2003) found no relationship between the use of lined or unlined paper and the handwriting legibility of kindergarten students.
Choosing Paper

- Initially, it may be helpful to use modified paper (within-stimulus prompting)
- Be sure to fade over time

Webber Handwriting Paper CD

CD available from Super Duper Inc.
Allows user to choose from pre-made paper or customize paper (# of lines, colors, boxes, size, visual cues, etc.)
Handwriting Without Tears

Insects have six legs.

Some walk on walls.

Few walk on water.

Smart Start Paper

Always do your best!
Keyboarding

- Handwriting difficulties are correlated with keyboarding difficulties (Connelly, Gee, & Walsh, 2007)
- Poor keyboarding skills have a negative impact on composition speed (Preminger, Weiss, & Weintraub, 2004)
- Keyboarding may be considered as a replacement for handwriting only after all other strategies have been tried (Handley-More et al., 2003)

Cursive

- Teaching cursive may not be functional for many learners with autism
- If cursive instruction is introduced, teaching a signature may be a functional goal
- The same teaching strategies previously reviewed can be applied to cursive instruction
Assessment

- VB-MAPP Writing Sub-Test
- Handwriting Without Tears
- Evaluation Tool of Children’s Handwriting
- Test of Handwriting Skills-Revised (THS-R)

VB-MAPP Writing Sub-test

- Criterion-referenced
- Includes several pre-writing skills (e.g. copying drawings, coloring, tracing) as well as printing letters
- Based upon skills displayed by typically developing 4-year-olds
- Appropriate for pre-writers and novice writers

Download for free test booklet from amymcginnis.com
PRINT Tool

• Ages: 6 and up
• Criterion-referenced
• Assesses capitals, numbers, and lowercase letter skills.
• The skills evaluated include: memory, orientation, placement, size, start, sequence, control, and spacing.

ETCH

• Grades 1 to 6
• Criterion-Referenced
• Testing Time: 15-25 minutes
• Scoring Time: 15-25 minutes
• The ETCH evaluates the manuscript and cursive handwriting skills of students in Gr. 1-6. It assesses handwriting speed and legibility in writing tasks similar to those required of classroom students.
• ETCH tasks include alphabet and numerical writing, near-point and far-point copying, dictation, and sentence generation.
• it assesses legibility components, pencil grasp, hand preference, manipulative skills with the writing tool, and classroom observations
THS-R

- Ages: 5-0 thru 18-11
- Testing/Scoring Time: 25 minutes
- Test Type: Norm Referenced
- Can be used to assess both print and cursive.
- Scoring guides for across common writing styles (e.g. Zaner-Bloser, HWT, D’Nealian, etc.)
- Subtest scores are reported as scaled scores and percentile ranks, and an overall standard score.
- Subtests include timed writing, as well as copying and dictation of letters, numbers, and words

Developing Goals

- When developing handwriting goals, a high level of specification is often necessary for progress monitoring
- Anyone who reads the goal should be able to understand what is being targeted
Developing Goals

Size
• Letters 2”, 1”, ½” ?
• Extensions (cross hatching) no more than ¼”, 1/8”, ?

Formation
• Legible to an unfamiliar reader?
• Correct use of angles / curves?
• Extensions?
• Incomplete approximations?
• Consider a rubric with visual examples, such as the THS-R rubric

Alignment / Orientation
• Slanting no more than 20 degrees?
• Where do letters start and end? On the line? Within ¼” or 1/8” of the line?

Spacing
• How much space between letters and words?
Developing Goals

Type of Writing
- Imitation
- Copying
- Dictation
- Composition

Setting
- 1:1 therapy instruction
- Familiar worksheets?
- Classroom routines?
- Across persons and settings?

Writing Sample
Writing Sample

Data Collection

- Cold Probes
- Retention and generalization probes
- Saved work samples
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Cumulative Acquisition Graph
Troubleshooting

• Too much pressure
• Not enough pressure
• Dominant forearm is not stabilized
• Wrist is flexed
• Non-dominant hand does not stabilize paper
• Staying between the lines
• Sizing
• Speed