

# 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

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#### ABSTRACT

**Background:** 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.

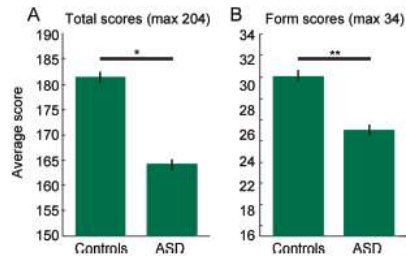
**Methods:** A case-control study of handwriting samples from children with and without autism spectrum disorders (ASD) was performed using the Minnesota Handwriting Assessment. Samples were scored on an individual letter basis in 5 categories: legibility, form, alignment, size, and spacing. Subjects 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)

Figure 2 Average total and form handwriting scores across groups



The control group averaged significantly higher total (A) and form (B) handwriting scores than did the autism spectrum disorders (ASD) group. Error bars represent standard error ( $p < 0.02$ ,  $^*p < 0.01$ ).

## Examples of Common Form Errors

Figure 3 Examples of autism spectrum disorders (ASD) 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-Steinhart, 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 35 third- and fourth-grade Jewish children using the Arel-Arel Klex Yaf Hebrew Handwriting Test. Simultaneously, we recorded the participants' upper trapezius and thumb 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 muscle displayed significantly less variability than the distal muscles. Decreased variability in proximal muscle activity was associated with decreased variability in distal muscle activity, and decreased variability in the distal muscles was significantly associated with faster speed of writing.

**CONCLUSION:** The lower amount of variability exhibited in the proximal muscle compared with the distal muscles seems to indicate that the proximal muscle functions as a stabilizer 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 treatment for children with handwriting disabilities.

Naider-Steinhart, S., & Katz-Leurer, M. (2011). Analysis of proximal and distal muscle activity during handwriting tasks. *American Journal of Occupational Therapy, 41*, 350-358.

## 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

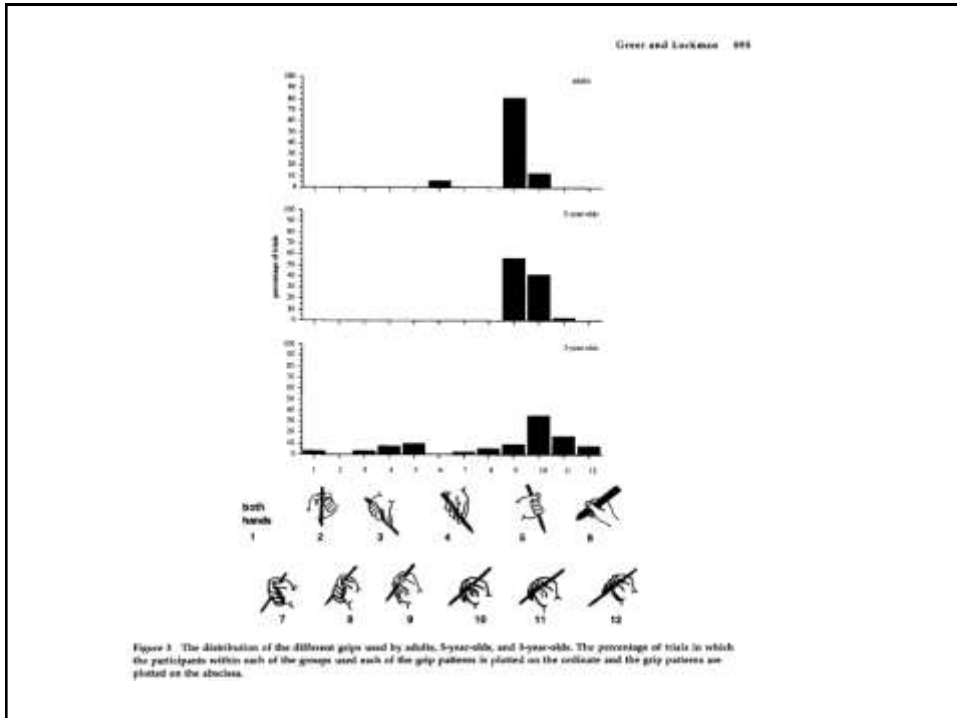
## Developmental Grasp Variations

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

### Using Writing Instruments: Invariances in Young Children and Adults

*Tammy Greer 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 3-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.

## Effect of Pencil Grasp on the Speed and Legibility of Handwriting in Children

Heidi Schwellnus, Heather Carnahan, Azadeh Kushki,  
Helene Polatajko, Cheryl Missiuna, Tom Chau

### KEY WORDS

- child
- hand strength
- handwriting

**OBJECTIVE.** Pencil grasps other than the dynamic tripod may be functional for handwriting. This study examined the impact of grasp on handwriting speed and legibility.

**METHOD.** We videotaped 120 typically developing fourth-grade students while they performed a writing task. We categorized the grasps they used and evaluated their writing for speed and legibility using a handwriting assessment. Using linear regression analysis, we examined the relationship between grasp and handwriting.

**RESULTS.** We documented six categories of pencil grasp: four mature grasp patterns, one immature grasp pattern, and one alternating grasp pattern. Multiple linear regression results revealed no significant effect for mature grasp on either legibility or speed.

**CONCLUSION.** Pencil grasp patterns did not influence handwriting speed or legibility in this sample of typically developing children. This finding adds to the mounting body of evidence that alternative grasps may be acceptable for fast and legible handwriting.

Schwellnus, H., Carnahan, H., Kushki, A., Polatajko, H., Missiuna, C., & Chau, T. (2012). Effect of pencil grasp on the speed and legibility of handwriting in children. *American Journal of Occupational Therapy*, 66, 718–726. <http://dx.doi.org/10.5014/ajot.2012.004515>

## Writing Grasp Research

- 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 quadropod 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

## Hand Strength, Handwriting, and Functional Skills in Children With Autism

Michele L. Alaniz, Eleanor Galit, Corina Isabel Necesito,  
Emily R. Rosario

### MeSH TERMS

- activities of daily living
- autistic disorder
- hand strength
- handwriting
- pinch strength

**OBJECTIVE.** To establish hand strength development trends in children with autism and to investigate correlations between grip and pinch strength, components of handwriting, and functional activities in children with and without autism.

**METHOD.** Fifty-one children were divided into two groups: typically developing children and children on the autism spectrum. Each child completed testing for pinch and grip strength, handwriting legibility, pencil control, and independence in functional activities.

**RESULTS.** The children with autism followed the same strength development trends as the typically developing children. Grip strength correlated with pencil control in both groups and with handwriting legibility in the typically developing children but not in the children with autism. Grip and pinch strength correlated with independence with functional activities in both groups.

**CONCLUSION.** This study provides evidence that grip and pinch strength are important components in developing pencil control, handwriting legibility, and independence with functional fine motor tasks.

Alaniz, M. L., Galit, E., Necesito, C. I., & Rosario, E. R. (2015). Hand strength, handwriting, and functional skills in children with autism. *American Journal of Occupational Therapy, 69*(6), 620-630. <http://dx.doi.org/10.5014/ajot.2015.016022>

## 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

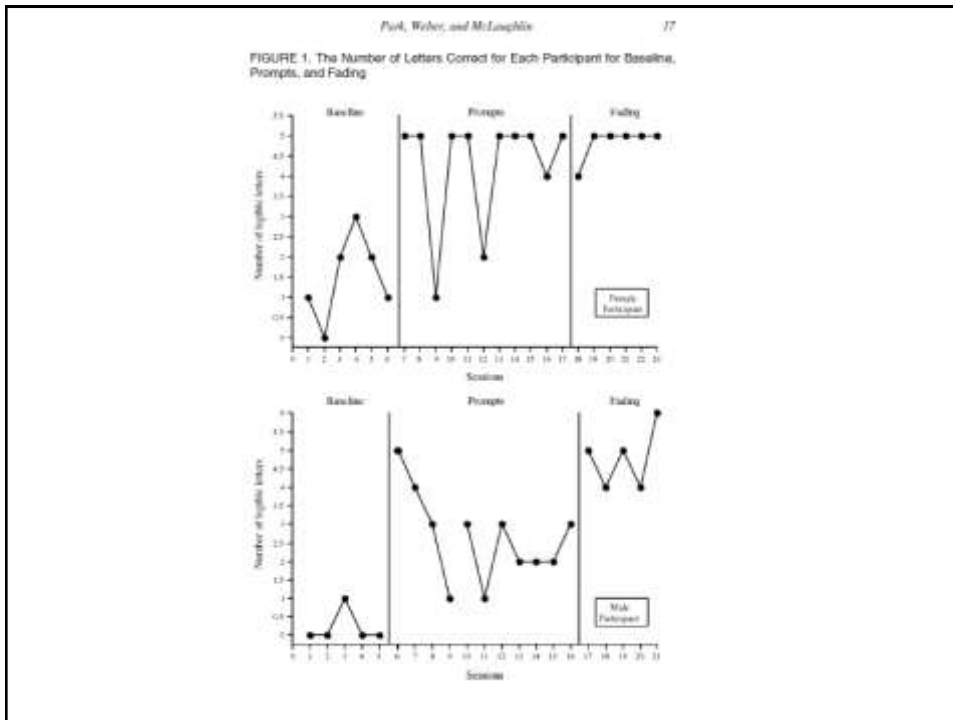
- Emphasize stopping at the corners
  - May need to pick marker up at first
- Dot prompts
- Verbal prompts
- Backwards chaining

## 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)

Park, Weber & McLaughlin (2007)

## Basics of Direct Instruction

Teacher: “Copy 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; Schweltnus et al., 2012)
- Wait for children to “grow out” of handwriting deficits (Feder & Majnemer, 2007)

J Dev Phys Disabil (2013) 25:493–503  
DOI 10.1007/s10822-012-9325-x

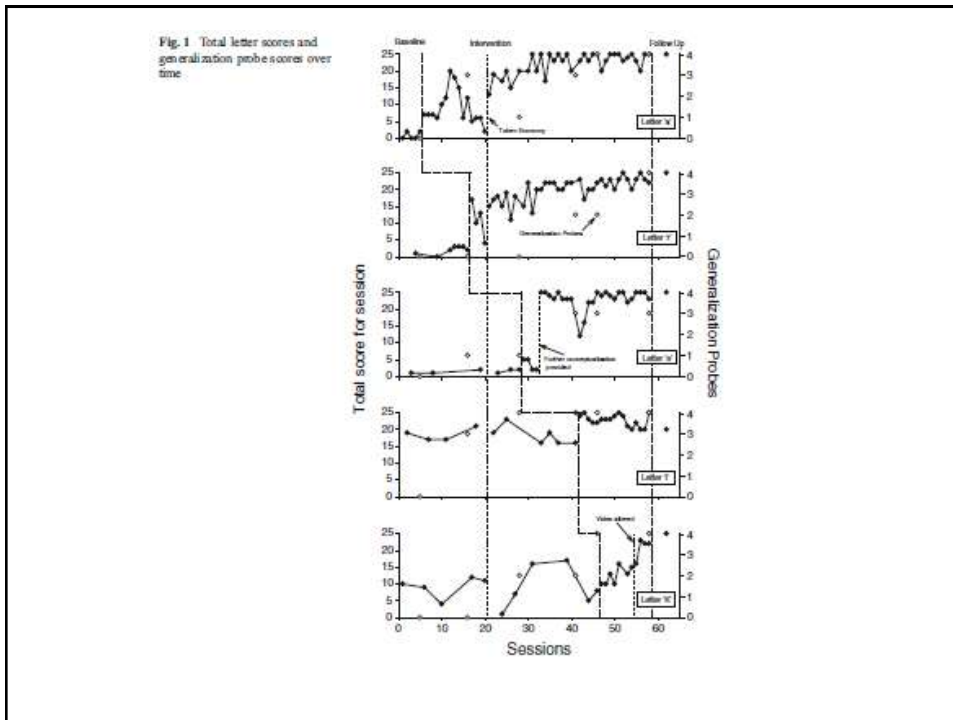
### A Video-Based Package to Teach a Child with Autism Spectrum Disorder to Write Her Name

Dennis W. Moore · Angelika Anderson ·  
Francesca Treccase · Joanne Deppeler ·  
Brett Furlonger · Robert Didden

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© Springer Science+Business Media New York 2013

**Abstract** The purpose of this study was to trial a procedure involving point-of-view video modeling, backward chaining and reinforcement to teach a child with ASD to write her name. Video modeling and reinforcement were used to teach letter writing, and backward chaining to produce the complete name. A multiple baseline across behaviors design treating each letter as a different behavior established the effectiveness of the procedure for teaching letter writing and generalization data suggest the efficacy of backward chaining in teaching production of her name. Treatment integrity was satisfactory and a post-intervention questionnaire indicated the intervention was acceptable to the participant's mother. These findings suggest that point-of-view video modeling in combination with backward chaining and reinforcement may be an effective tool for teaching new academic skills.

**Keywords** Autism · Backward chaining · Point-of-view video modeling · Reinforcement · Writing



## 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).

## 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



# Smart Start Paper



## 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

## 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](http://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

## Developing Goals

### 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

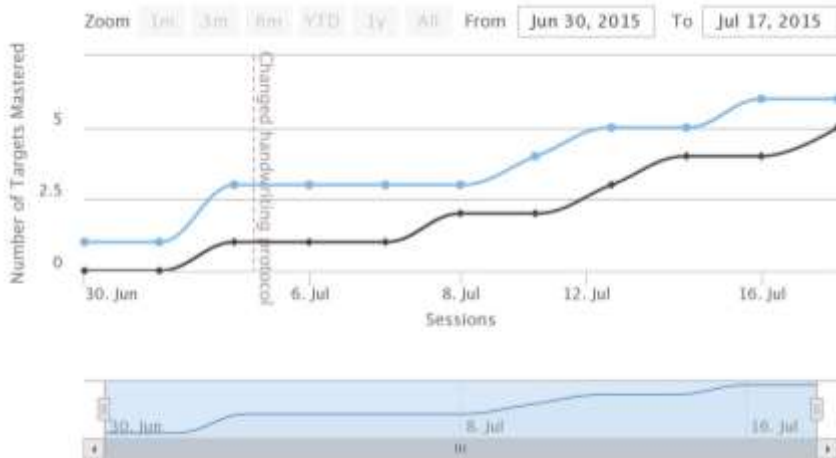
- 1:1 therapy instruction
- Familiar worksheets?
- Classroom routines?
- Across persons and settings?

## Data Collection

- Cold Probes
- Retention and generalization probes
- Saved work samples

Writing				
⊞ WR-05 - Prints form of lowercase letters (Active)				
	Date Introduced	Date Mastered	Date Generalized	
c (Probe)	2015-06-30	2015-06-30	2015-06-30	
o (Probe)	2015-06-30	2015-07-02	2015-07-02	
s (Probe)	2015-06-30	2015-07-02	2015-07-08	
v (Probe)	2015-07-02	2015-07-10	2015-07-13	
w (Probe)	2015-07-02	2015-07-13	2015-07-14	
x (Probe)	2015-07-13	2015-07-16	2015-07-17	
z (Probe)	2015-07-16	-	-	
t (Probe)	2015-07-17	-	-	
a (Probe)	-	-	-	
d (Probe)	-	-	-	
g (Probe)	-	-	-	
u (Probe)	-	-	-	
i (Probe)	-	-	-	

## 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