Printing Like a Pro!: An evidence-based printing progam for primary students

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Outline

- Describe the latest research in handwriting intervention
- Describe how "Printing Like a Pro!" was conceived
- Review "Printing Like a Pro!" program
- Discussion and Questions

Cognitive Versus Multisensory Approaches to Handwriting Intervention: A Randomized Controlled Trial

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key words: handwriting intervention, randomized controlled trial, occupational therapy

ABSTRACT

The purpose of this study was to compare the effect of cognitive versus multisensory interventions on handwriting legibility of elementary school students referred to occupational therapy for handwriting difficulties. In this randomized controlled trial, 72 first- and second-grade students were assigned to either a cognitive intervention, multisensory intervention, or control (no intervention) group. Letter legibility was measured using the Evaluation Tool for Children's Handwriting before and after 10 weeks of intervention. Analysis of variance of change scores showed no statistically significant difference across the three groups. First-grade students improved with or without intervention, but second-grade students showed sizeable improvement with cognitive intervention compared to multisensory intervention (d = 1.09) or no intervention (d = .92). These results challenge current occupational therapy practice of using a multisensory approach for remediation of handwriting difficulties for students in second grade. A cognitive approach to handwriting intervention shows greater promise and is worthy of further investigation.

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Background

- 92.1% of school-based occupational therapists (OTs) in the US use a multisensory approach to handwriting intervention (Woodward & Swinth, 2000)
- Canadian OTs use an eclectic approach, but 90% select a sensorimotor approach (Feder, Majnemer, & Synnes, 2000)
- Evidence for multisensory intervention is sparse and inconclusive (Oliver, 1990; Harris & Livesey, 1992; Lockhart & Law, 1994)

Rationale

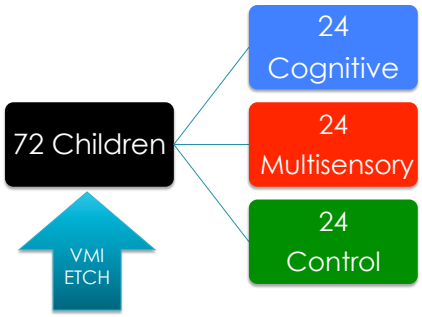
- Previous research has shown that handwriting intervention was effective, but unsure which part of eclectic intervention was effective (Case-Smith, 2002; Peterson & Nelson, 2003)
- Preliminary evidence suggests that a cognitive approach may be most effective (Graham et al., 2000; Miller et al., 2001; Jongmans et al., 2003)
- At the time of this study, cognitive and multisensory approaches had not been empirically compared

Purpose

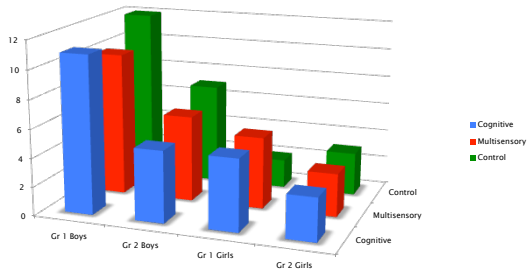
- to compare the effectiveness of cognitive versus multisensory interventions in improving the handwriting legibility of children in grades 1 and 2 who have been referred to school-based occupational therapy
- Handwriting = printing, manuscript

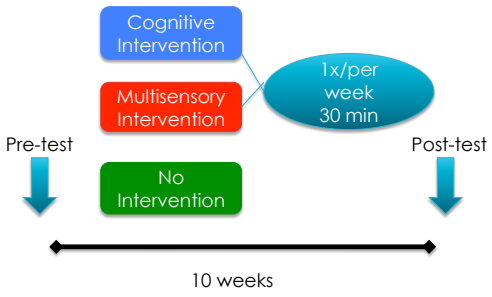
Hypotheses

1. Children who received cognitive or multisensory intervention would show greater improvement in handwriting legibility (as measured by ETCH-M) compared to children in the control group
2. Children who received cognitive intervention would show greater improvement in handwriting legibility compared to children receiving multisensory intervention



Distribution of Gender and Grade Across Groups



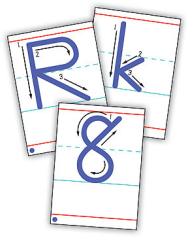


Session	Letter Formations	Letters
1	Crazy C Letters	*c, a, d*
2		*g, q, o*
3	Down & Up Letters	*b, h, n*
4		*m, p, r*
5	Stop & Go Letters	*f, i, j*
6		*k, t, x*
7	Stop & Go Letter; Ski Slope Letters	*y, v, w*
8	One of a Kind Letters	*e, l, s*
9		*u, z*
10	Review of three letters that were particularly difficult for the child	

Cognitive Intervention

The cognitive intervention group followed a similar format to the procedures outlined by Graham et al. (2000):

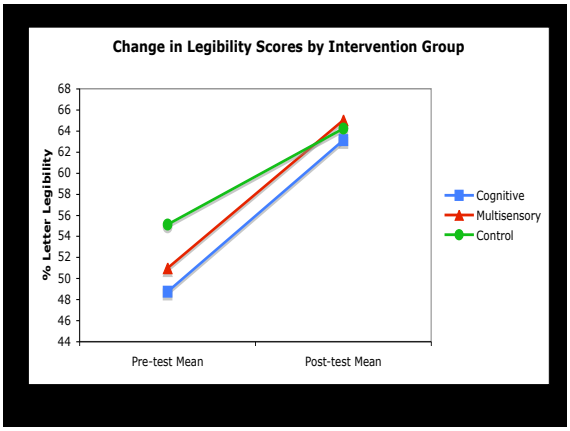
- Alphabet Warm-Up
- Modeling
- Imitation
- Discussion
- Practice
- Evaluation

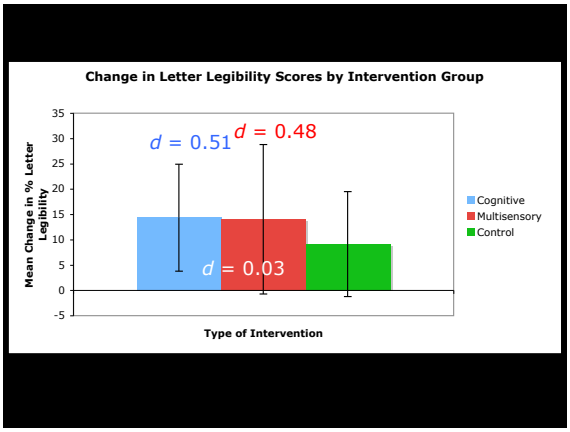


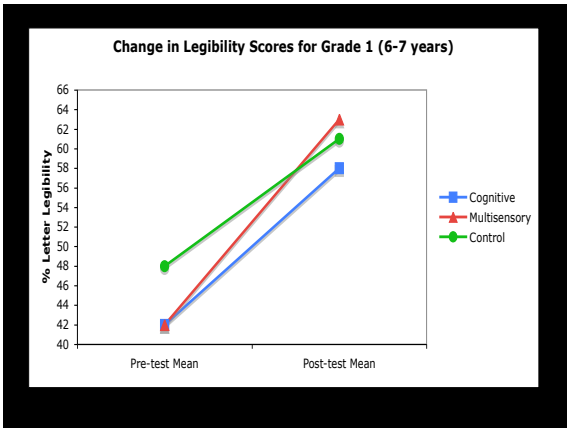
Multisensory Intervention

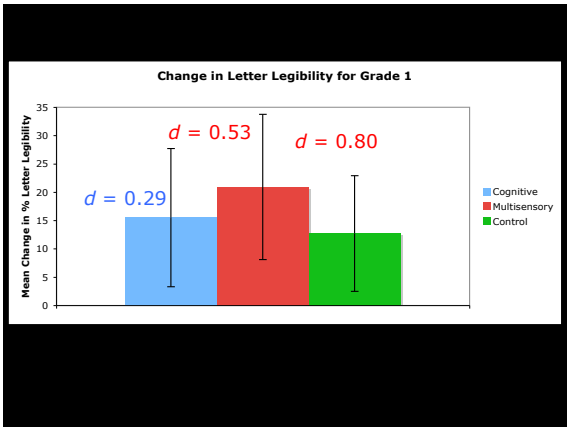
The multisensory intervention was based on information in the literature as well as from feedback from occupational therapists participating in the study (Amundson & Weil, 2001; Woodward & Swinth, 2002)

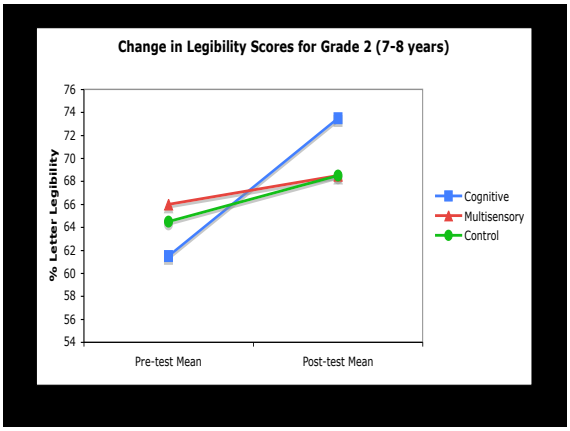
- Writing on chalkboard
- "Sky-writing"
- Tracing letters in cornmeal
- Tracing over bumpy glitter glue letters
- Copying letters with coloured markers on worksheet
- Copying letters with pencil on lined paper

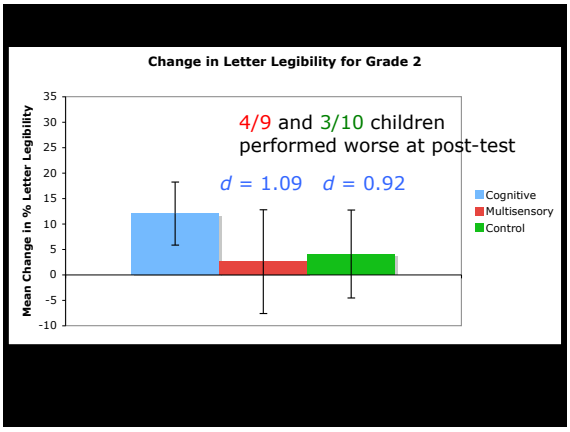












Students in Grade 1

- showed improvement in handwriting legibility whether they received intervention or not
- just learning to print – more room for improvement and refinement over the school year
- receiving explicit instruction
- much of handwriting research has looked at grade 1 students – but they improve without intervention…

Students in Grade 2

- did not show improvement without intervention – consistent with literature (Hamestra-Bletz & Blöte, 1993; Jongmans et al., 2003)
- multisensory intervention had little or worsening effect on their handwriting legibility
- all grade 2 students receiving cognitive intervention demonstrated improvement in legibility – may be due to further cognitive development and greater meta-cognitive skills; no longer receive explicit instruction in class

Limitations

- Insufficient intensity or frequency of intervention
- Similarity of interventions
- Small sample size for secondary analyses
- Insufficient sensitivity of ETCH to measure subtle changes in handwriting legibility
- No assessment of other factors that contribute to handwriting performance
- Variability in amount and type of in-class handwriting instruction may have influenced results

Denton et al., 2006

- 38 children 6-11 years with handwriting dysfunction
- RCT comparing sensorimotor intervention (SM) (n = 14), therapeutic practice (TP) (n = 15), and no intervention (n = 9)
- SM – visual perception, visual motor integration, proprioception/kinesthesia, in-hand manipulation
- TP – handwriting practice – copying, dictation, from memory
- Intervention 4x/week for 5 weeks (10 hours)

Denton et al., 2006

- No interaction effect between group and change in handwriting scores (copy, dictation, memory) on THS from pre- to post-test
- Taking all handwriting scales together:
  - significant improvement in handwriting performance for TP group
  - decline in performance for SM group
  - no change in control group

Limitations of Denton et al., 2006

- Small sample size
- Unequal group size
- Therapist varied intervention
- Sample varied in age and type of handwriting (manuscript and cursive)
- Amount and type of handwriting instruction unknown
- Likely insufficient practice dose to obtain robust effects

Consistencies between Zwicker and Denton studies

- Cognitive intervention and therapeutic practice tended to be superior to multisensory/sensorimotor intervention
- Generally, older children receiving multisensory/ sensorimotor intervention showed decline in handwriting performance
- 5 – 10 hours of intervention produced modest effects

Sudsawad et al., 2002

- 45 first-grade students (6-7 years)
- RCT comparing kinesthetic training (KT), handwriting practice (HP), and no intervention
- KT – practice on Run Away task and Pattern task
- HP - copying letters, words, and sentences with visual/verbal feedback for letter size, alignment, and spacing
- Daily intervention for 30 min for 6 days

Findings of Sudsawad et al., 2002

- No significant improvement in ETCH scores, but significant handwriting improvement in all groups as per teacher report
- Limitations
  - Insufficient practice dose
  - Kinesthetic training was the same as assessment
  - Subjective report from teachers
  - Intervention near end of school year
  - Note: sample was grade 1 students (who improved with or without intervention in Zwicker et al.'s study)

Similarities between Sudsawad and Denton Studies

- Kinesthetic training had no effect on handwriting legibility or speed
- All groups improved in kinesthesis without significant gains in handwriting performance
- Sensorimotor training had a small to modest effect on in-hand manipulation and visual perception, but these improvements did not lead to improvements in handwriting (in fact, had clinically meaningful decline in handwriting)

Mackay et al., 2010

- 16 Year 1 and 2 students (6-8 years)
- 8 weekly task-specific handwriting sessions of 45 min conducted in groups of 2-3 students + homework
- Letters practiced in dish of rice, then on paper (writing line was brown (log) and letters were introduced as animals living in the log)
- Verbal instruction, feedback, and modelling

Mackay et al., 2010

- Significant improvements in handwriting legibility (15%) – similar to Case-Smith (2002) and Zwicker et al. (2009)
- Limitations
  - Small sample size
  - No control group
  - Note: sample included 6-7 year olds (who improved with or without intervention in Zwicker et al.'s study)

Weintraub et al., 2009

- 55 students in Grades 2-4
- RCT of task-specific (TS), task-specific + sensorimotor (SM), and no intervention
- TS – direct practice and feedback
- SM – postural control, bilateral coordination, fine motor skills, multisensory writing experiences, handwriting instruction
- Common to both: letter instruction using mnemonics, self-evaluation, homework

Weintraub et al., 2009

- 8 weekly one hour sessions in groups of 4-6 students

Results

- TS and SM showed improvement in legibility compared to control group, but significant improvement only noted in TS group
- No improvement in control group
- TS group showed significant improvement in spatial organization 4 mo after intervention

Weintraub et al., 2009

Strengths

- Sample included older children in grades 2-4
- Included follow-up data
- Showed that sensorimotor intervention had no additional benefit (and perhaps took away from) cognitive elements of intervention

Integrating the Evidence

- Continues to be little evidence for multisensory and sensorimotor approaches
- Multisensory approach may have some advantage for youngest students, but they appear to improve without additional intervention
- Older students are disadvantaged by multisensory/ sensorimotor approach

Integrating the Evidence

- Cognitive approaches appear to have the best results
- Common features:
  - Numbered arrow cues (Berninger et al., 1997)
  - Recalling letter formation from memory (Graham et al., 2000)
  - Self-instruction/verbal mediation (Graham et al., 2000; Miller et al., 2001)
  - Self-monitoring & evaluation (Graham et al., 2000)
  - Task-specific (Jongmans et al., 2003; Miller et al., 2010)

Results from Systematic Review

- Hoy, Egan & Feder (2010) conducted SR of handwriting interventions
- Concluded that **handwriting practice** was essential for improvement, consistent with motor learning theory (Zwicker & Harris, 2009)
- Recommended minimum of 2x/week practice over 20 sessions

Additional Food for Thought

- Current studies of intervention seem to be under-dosed to produce robust effects
- Likely need greater frequency and intensity to produce neuroplastic change in struggling writers… how much intervention is the next step for further investigation

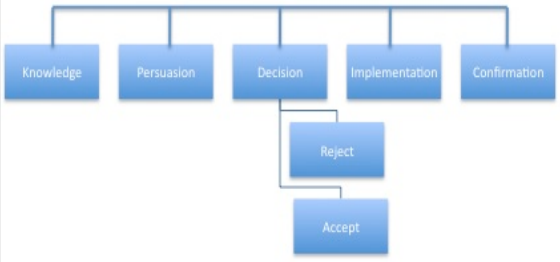
Development of SunnyHill Printing Program

- Timeline:
- Need:
- Solution required:
  - Easily available
  - low cost
  - easy to use (due to consultative nature of Outreach OT service)
  - parent and school friendly

Development of SunnyHill Printing Program

- Search Results/Evidence Based Practice Findings (early 1990's):
  - Multisensory approach:
  - Developmental Progression:
  - Program Development:
    - Program handout
    - Letter worksheets
- Incorporation of Consumer Feedback

Diffusion of Innovations (DOI) Theory



Rogers, 1995

Five stages in DOI decision process:

- **New Knowledge**: preliminary research results (CAOT conference, 2005)
- **Persuasion**: Opinion formed from intriguing results
- **Decision**: Choose whether to adopt the new knowledge. In our case – Acceptance!
- **Implementation**: I modified the printing program and the worksheets to be cognitively based
- **Confirmation**: Confirm the decision about using the /new knowledge/innovation

Implementation Stage:

- Literature supports a more cognitive approach to teaching handwriting for all types of learners
- Therefore Occupational Therapists as "handwriting/printing experts" are prime messengers of this message to school staff and parents

Printing – Importance in school

- #1 reason for referral to school based OT (Feder et al, 2008)
- 31-60% of day spent handwriting and other fine motor tasks (Feder et al, 2008)
- Handwriting constitutes the primary way that elementary school students demonstrate their knowledge in all academic areas (Case-Smith 2002)
- Academic failure can result from problems associated with poor handwriting (Case-Smith 2002)

Sunny Hill Health Centre for Children
Therapy Department

Printing Like a Pro!

A Cognitive Approach to
Teaching Printing to
Primary School Aged Children

(For School Staff)

Developed by Ivonne Montgomery, Occupational Therapist,
Edited by Jill Zwicker, PhD, OT(C)

Population:

- Primary years (grade 1 and 2)
- Mild motor impairments
  - High incidence or uncategorized: e.g., DCD or LD
  - Low incidence: e.g., Down Syndrome, Autism Spectrum Disorder, students with Chronic Health designations

Service Delivery

- Consultative model – for school staff (or parents)
- Designed for one to one or small group work
- Plus:
  - Adaptations and Modifications
  - Follow up

Cognitive Approach

- 3 Key features:
  - Visual cues : numbered arrows
  - Self talk: **i = down • lift • dot**
  - Self evaluation: "circle your best 3 letters"

Visual Cues

- Numbered arrows cues:
  - show order and direction of stroke for each letter (Berninger et al.,1997; Graham 2009; Graham, Harris & Fink, 2000; Zwicker & Hadwin, 2009)

Self Talk

i = down •lift • dot

- A learning strategy that uses verbal mediation to guide letter formation (Zwicker & Hadwin, 2009)
- Verbalization of directions of proper letter formation/ direction of movement (Graham et al., 2000; Graham and Weintraub, 1996, Weintraub et al., 2009; Zwicker & Hadwin, 2009)
- Repeat the same set of directions each time
- Later fade out use as printing becomes more automatic -" temporary crutch") (Graham & Weintraub, 1996)

Self Evaluation

- Encourage student to circle best formed letters based on set criteria for *each* letter (Graham & Weintraub, 1996; Graham et al., 2000; Jones & Christensen, 1999; Weintraub et al., 2009; Zwicker & Hadwin, 2009)
- It is important for the student to look at their work to see how closely their letter formation matches the target letter – with adult guidance

Additional Key Features

- **Teach printing as a separate entity** ("supplemental instruction") (Graham, 2010; Graham et al., 2000)
- **Frequency and Duration/Intensity**:
  - shorter more frequent lessons (Graham, 2009; Denton et al, 2006)
  - aim for a total of 75 – 100 minutes of total handwriting instruction per week (Graham, 2009)

Additional Key Features

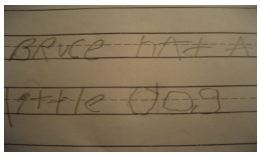
- **Modeling/Demonstration:**
  - Model how to form each letter using a chalkboard or white board (Graham et al., 2000; Graham & Weintraub, 1996; Weintraub et al., 2009; Zwicker & Hadwin, 2009)
  - Verbal Modeling: describe out loud how to form each letter (Graham & Weintraub, 1996; Graham, Harris & Fink, 2000, Zwicker & Hadwin, 2009)
- **Practice:**
  - first imitation, then copying (Graham, 2009; Zwicker & Hadwin, 2009)
- **Memory retrieval:**
  - later writing the letter from memory (Berninger, 1997; Graham, 2009; Zwicker & Hadwin, 2009)

Additional Key Features

- Start each lesson with a review or warm-up (MacKay et al., 2010)
- Document which letters are tricky for the student and focus extra on those (Graham, 2009)

Additional Key Features

- Teach lower case letters first, then uppercase (Jones & Christensen, 1999; Graham et al., 2000; Graham 2009; Zwicker & Hadwin, 2009)
- Lower case letters are used more in classroom printing (and in reading) than upper case (Berninger, et al., 2009)
- Example of "letter case confusion"

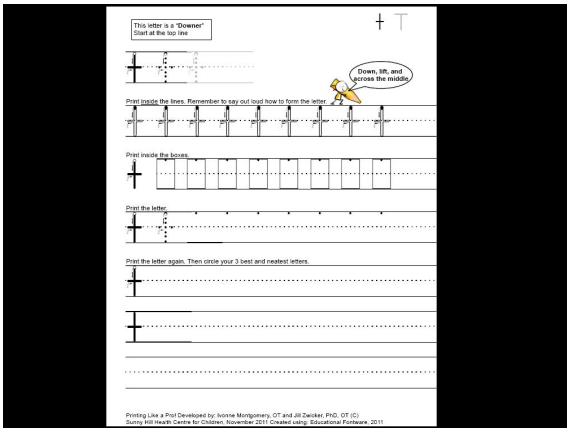


Additional Key Features – Teach lower case first !

- Lasting effects of learning upper case first (adult writing sample)

Additional Key Features

- Use a variety of writing implements including chalk, followed by use of letter worksheets (Denton et al., 2006; Graham & Weintraub, 1996; Weintraub et al., 2009)
- Letter Worksheets:
  - Created using : Educational Fontware 2011
  - One letter per page (Graham et al.,2000, Zwicker & Hadwin, 2009)



Developmental progression

- Organized in a developmental progression of "letter groupings" (Beery & Beery, 2004)
- Each group's letters are:
  - Labeled/titled e.g., " Downers" (Weintraub et al., 2009 Mackay et al., 2010; Graham et al., 2000; Zwicker & Hadwin, 2009)
  - Formed the same way and share common formational characteristics – thought to reinforce correct motor patterns for letter formation (Graham, 2009; Zwicker & Hadwin, 2009)

Developmental progression

- Letters that are easier to form are introduced before more difficult ones (Beery & Beery, 2004; Graham, 2009)
- If possible, ordered so that each letter motor pattern builds on the next
- Also – grouped based on similar verbal self talk
- Additionally - letters that could be easily confused or reversed are not in the same group:
  - e.g., u and n or d and b

Developmental Groupings - Lower case letters

- **Downers** l i t f (Group 1)
- **Rounders** c o e a d (Group 2)
- **Curvers (special)** s u (Group 3)
- **Curvers** r n m h b (Group 4)
- **Diggers** j g q p (Group 5)
- **Sliders** v w y x z k (Group 6)

easiest

most difficult

Sunny Hill Health Centre for Children
Therapy Department

Letter Worksheets

A Cognitive Approach to
Teaching Printing to
Primary School Aged Children

Developed by Ivonne Montgomery, Occupational Therapist,
Edited by Jill Zwicker, PhD OT(c)

Printing Like a Prof Developed by: Ivonne Montgomery, OT and Jill Zwicker, PhD OT (c)
Sunny Hill Health Centre for Children 2010 Created Using: Educational Footware, 2010

Downers

l, i, t, f

Group 1

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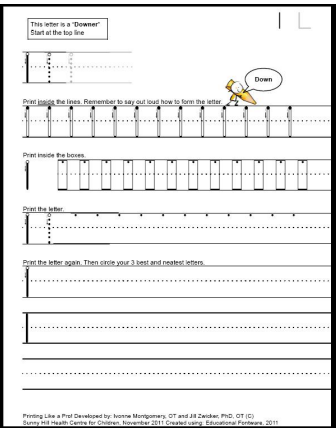

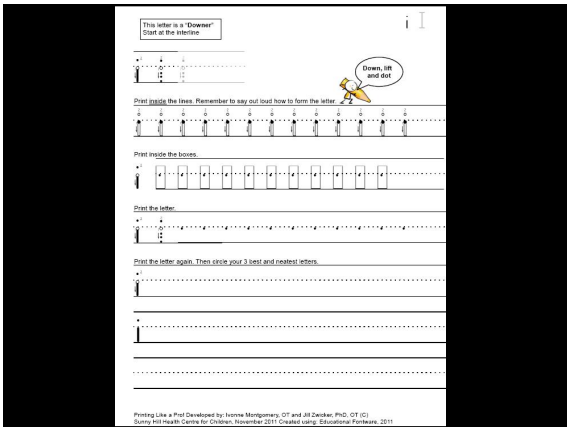

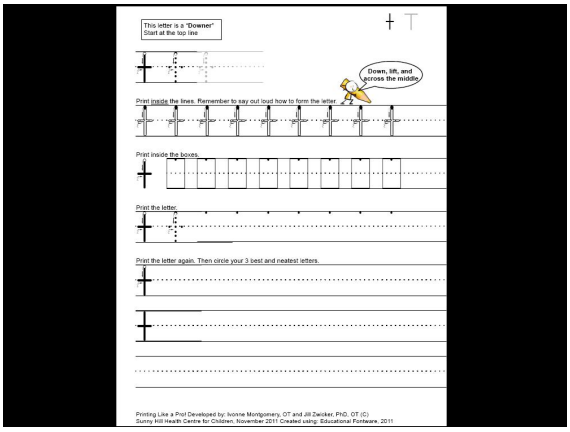

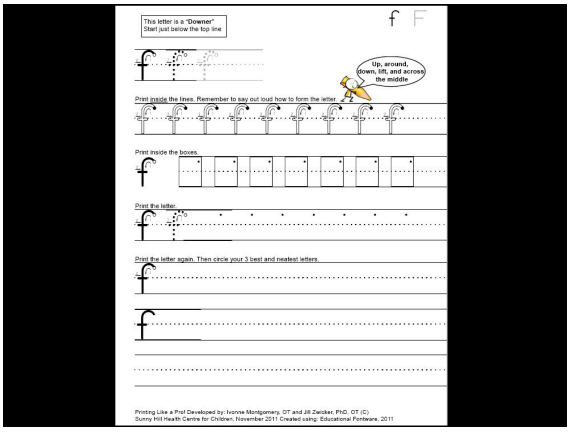

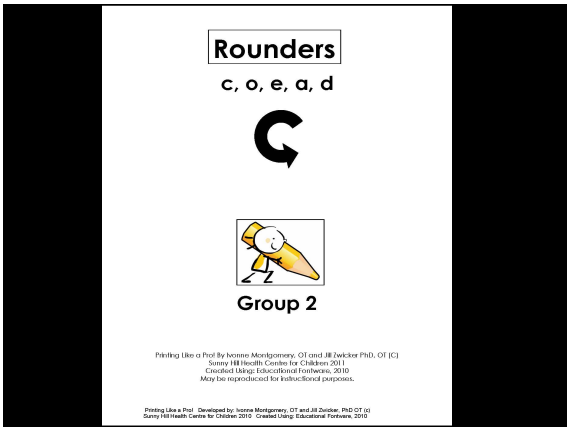

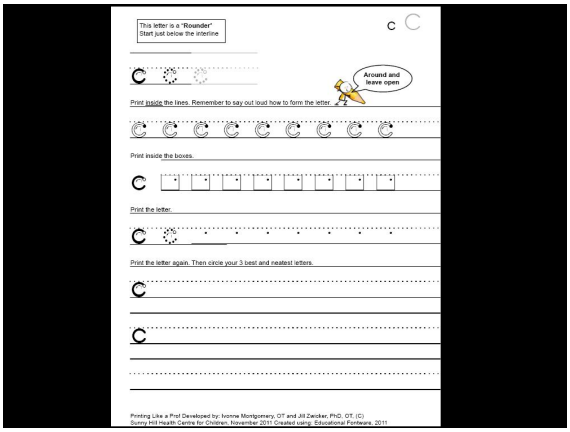

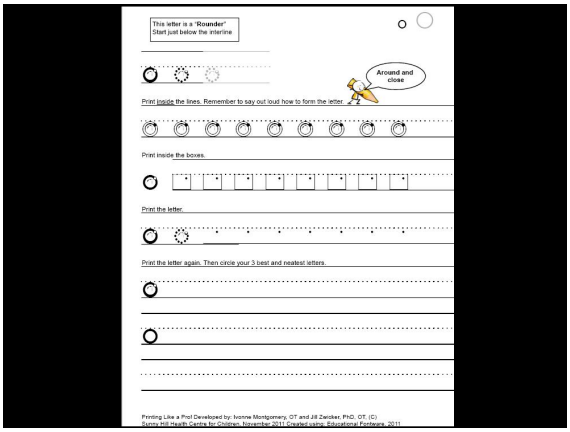

Developmental Groupings - UPPER CASE letters

Downers (Group 1)	L T I H F E	easiest
Rounders (Group 2)	C O Q G	
Curvers (special) (Group 3)	S U J	
Curvers (Group 4)	P B R D	
Sliders (long) (Group 5)	V W X A N M Z	
Sliders (short) (Group 6)	Y K	most difficult

Reuse of worksheets

- Laminate or use page protectors
- Use with overhead fine tip markers (wipe clean with a wet paper towel)

School vs. Parent Version

- Developed 2 versions
  - School staff – Teachers and SEAs
  - Parent and Caregiver
- Slightly different content and writing level/implied knowledge
- Ideal to use both - at home and at school

CDR Website

- The school and home versions are available on the CDR website --- http://www.childdevelopment.ca/School-Age_Therapy_Practice_Resources.aspx

Other Printing Programs

- Many other good programs out there
- SHHCC would like to add this "Evidence Based Practice" resource to the mix
- Consumer education and consumer choice

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