Testing the Use of an iPad Application to Decrease Letter and Number Reversals in First Grade Students

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RP 202
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Background

- 42% of lowest scoring writers in kindergarten also lowest scoring in first grade (Marr & Cermak, 2003)

Aspects of Handwriting

Problem:

- Increasing number of Handwriting Referrals
- Addressing the needs: Handwriting Instruction

"By contributing to the effectiveness of the initial handwriting instruction, occupational therapists can ensure that all students receive proper instruction. Then, only those students who have genuine deficits best addressed by occupational therapy would be referred for remediation, allowing therapists to better manage their caseloads." p. 469 (Asher, 2006)
Clinical Question
- Could an iPad application be an adjunct to helping "developing handwritters" with practice and attainment of stronger handwriting skills?
- And, if so:
  - Would OT then have fewer referrals but referrals of children with genuine deficits?

What do we know about technology and writing?
- Technology’s role in remediation of handwriting has not been an area highly researched.
- Computerized programs - often been proven to be effective with students with disabilities, such as to improve communication (Hetzroni & Tannous, 2004)
- Students with autism spent more time on task with reading (Williams, Wright, & Callahan, 2002)
- Students trained on a computer visual perceptual program improved their visual perceptual skills, but not handwriting legibility (Poon, Li-Tsang, Weiss, & Rosenblum, 2010)

Why the iPad?
- Lightweight and inexpensive
- Can be used anywhere
- Various gestures of the digits
  - pinch and flick
- Accelerometer
  - detects and measures movement, speed, and distance
Why the iPad specific to handwriting?

- Gaining popularity for students with disabilities due to its ease of use and accessibility (Harrison, 2010)
- The iPad is believed to be able to “extend what can be done in classrooms” (Murray & Olcese, 2011, p. 47)

Research Question

- Will first grade children, identified with handwriting reversal and letter identification problems, improve directionality and decrease reversals when writing with iPad application training compared to students assigned to only receive traditional handwriting instruction?

Subjects

- First grade students
- Two suburban schools
- 103 out of 135 available first grade students had parent consent and participant assent
- Included
  - Regular education students
  - Students with identified learning disabilities that receive itinerant learning support services
- Excluded
  - Students in the Life Skills or Multi-disabilities programs.
Variables/Measures

- Jordan Left-Right Reversal Test, 3rd edition (JLRRT-3)

- Handwriting Assessment

Intervention

- Training LetterReflex (BinaryLabs, Inc., 2011)

  - Marketed as:
    - Fun and engaging
    - Help students overcome reversals

  - Training Protocol
    - 5-10 minutes
    - 2X per week
    - 12 weeks
    - ‘Tilt it’ and ‘Flip it’ activities
    - improve kinesthesia and directionality
    - designed to work on letter reversals
Handwriting Instruction

- Students also received handwriting instruction as determined by the teacher
- The control group

Post-tests:
  - JLRRT-3
  - Handwriting Assessment

Data Analysis

- 47 students participated (20 girls, 27 boys)
- Attrition: 20 students
- Analysis completed on 27 students total
  - 12 intervention
  - 15 control
## Pre and Post-test Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group</th>
<th>Comparison Group</th>
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<tbody>
<tr>
<td></td>
<td>Pretest M (SD)</td>
<td>Posttest M (SD)</td>
<td>Pretest M (SD)</td>
<td>Posttest M (SD)</td>
</tr>
<tr>
<td>JLRRT - Subtest 1A</td>
<td>9.06 (2.539)</td>
<td>10.06 (2.109)</td>
<td>10.06 (1.713)</td>
<td>10.59 (2.022)</td>
</tr>
<tr>
<td>Accuracy Raw Score</td>
<td>5.56 (4.582)</td>
<td>2.58 (4.122)</td>
<td>3.76 (1.474)</td>
<td>2.35 (2.936)</td>
</tr>
<tr>
<td>Error Raw Score</td>
<td>12.92 (4.461)</td>
<td>13.57 (2.462)</td>
<td>11.41 (5.568)</td>
<td>13.16 (3.777)</td>
</tr>
<tr>
<td>Lower-Case percentage without reversals</td>
<td>94.21 (6.453)</td>
<td>95.45 (3.834)</td>
<td>94.02 (5.486)</td>
<td>95.29 (4.823)</td>
</tr>
<tr>
<td>Lower-case percentage without reversals</td>
<td>97.20 (4.622)</td>
<td>95.32 (4.050)</td>
<td>95.29 (4.526)</td>
<td>95.29 (4.036)</td>
</tr>
<tr>
<td>Numerals percentage without reversals</td>
<td>87.73 (4.236)</td>
<td>96.14 (4.328)</td>
<td>87.37 (1.957)</td>
<td>96.07 (5.477)</td>
</tr>
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</table>

### Two-Way Analysis of Variance (ANOVA)

#### Tests of Within-Subjects Effects (between test scores)

(SSPS repeated measures ANOVA results with Greenhouse-Geisser correction)

<table>
<thead>
<tr>
<th>Subtest</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>JLRRT - Subtest 1A</td>
<td></td>
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<tr>
<td>Accuracy</td>
<td>567</td>
<td>.458</td>
<td>.021</td>
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<tr>
<td>Error</td>
<td>288</td>
<td>.596</td>
<td>.011</td>
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<tr>
<td>JLRRT - Subtest 1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>181</td>
<td>.674</td>
<td>.007</td>
</tr>
<tr>
<td>Error</td>
<td>519</td>
<td>.477</td>
<td>.019</td>
</tr>
<tr>
<td>Lower case</td>
<td>390</td>
<td>.538</td>
<td>.014</td>
</tr>
<tr>
<td>Upper case</td>
<td>150</td>
<td>.702</td>
<td>.006</td>
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<tr>
<td>Numerals</td>
<td>032</td>
<td>.860</td>
<td>.001</td>
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</table>

#### Tests of Between-Subjects Effects (between groups - iPad versus control)

<table>
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<th>F</th>
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<th>Partial Eta Squared</th>
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</thead>
<tbody>
<tr>
<td>JLRRT - Subtest 1A</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>1.074</td>
<td>.309</td>
<td>.038</td>
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<tr>
<td>Error</td>
<td>1.391</td>
<td>.249</td>
<td>.049</td>
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<tr>
<td>JLRRT - Subtest 1B</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.000</td>
<td>.998</td>
<td>.000</td>
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<tr>
<td>Error</td>
<td>4.568</td>
<td>.042</td>
<td>.145</td>
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<tr>
<td>Lower case</td>
<td>042</td>
<td>.839</td>
<td>.002</td>
</tr>
<tr>
<td>Upper case</td>
<td>1.787</td>
<td>.193</td>
<td>.062</td>
</tr>
<tr>
<td>Numerals</td>
<td>617</td>
<td>.439</td>
<td>.022</td>
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Study Findings

- **Significant difference**
  - In the amount of errors made when identifying reversals on JLRRT-3

- **No significant difference**
  - Recognizing reversed designs
  - Recognizing reversed letters and numbers
  - Forming lower-case and upper-case letters without reversals
  - Forming numbers without reversals

Limitations

- Testing environments
- Not Blind
- Small sample size
- Data from app
- Rely on student
- Practice Effect
Discussion

- Maturation
- Motor learning theory
- Practice

Where to go from here...

- Future studies:
  - Larger sample sizing
  - Apps that involve forming letters

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References
