Tier 2 and Tier 3 Reading Interventions: Skill by Treatment Interaction

Matthew Burns, Ph.D.

Aptitude by Treatment Interaction (ATI)

- Differential intervention effectiveness based on student aptitudes (cognitive processes).
- Chronbach, 1957
- Makes intuitive sense – popular.

Meta-analyses for ATI Interventions

Kavale & Forness, 2000
- Psycholinguistic training .39
- Modality instruction .15
- Perceptual training .08
- Auditory Sequential Memory .32
- Visual Sequential Memory .27
ATI???

The original architects of ATI concluded that cognitive abilities alone did not explain individual differences in intervention effectiveness (Cronbach & Snow, 1977).

Resurgence in ATI

- RTI – tier 3
- Measures of cognitive processes:
  - abilities would predict student outcomes better than CBM (Hale, 2006)
  - Provide data useful for designing interventions (Fiorello et al, 2006; Floyd et al., 2003; Hale et al., 2001).
- Current measures of underlying aptitudes are more sophisticated than those used in Cronbach's research (Swanson, 1987).

Merge Neuropsych and RTI (Feifer, 2008)

- We should assess cognitive constructs such as verbal IQ, executive functioning, working memory, attention, and reading fluency
- “Specifying the underlying linguistic and cognitive factors associated with poor reading comprehension skills may be helpful toward developing more effective intervention strategies to assist children” (p. 824), especially for those receiving a Tier 3 intervention.
Meta-Analysis Neuropsych.

<table>
<thead>
<tr>
<th>Variable</th>
<th>k</th>
<th>Median Adjusted</th>
<th>Hedge's g</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Cognitive Functioning</td>
<td>3</td>
<td>.09</td>
<td>-.50 to .68</td>
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<tr>
<td>Phonological/Phonemic Awareness</td>
<td>11</td>
<td>.44</td>
<td>.24 to .64</td>
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<tr>
<td>Rapid Naming</td>
<td>2</td>
<td>.48</td>
<td>.03 to .93</td>
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<tr>
<td>Verbal Memory</td>
<td>1</td>
<td>.20</td>
<td>NA</td>
<td></td>
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<tr>
<td>Reading Fluency</td>
<td>11</td>
<td>.43</td>
<td>.29 to .57</td>
<td></td>
</tr>
<tr>
<td>Attention</td>
<td>1</td>
<td>.13</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>5</td>
<td>.33</td>
<td>.13 to .53</td>
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</table>

Results

<table>
<thead>
<tr>
<th>Assessment Group</th>
<th>k</th>
<th>Median Adjusted</th>
<th>Hedge's g</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Cognitive Measures</td>
<td>8</td>
<td>.17</td>
<td>-.07 to .41</td>
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<tr>
<td>Phonological/Phonemic Awareness</td>
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<td>.50</td>
<td>.34 to .66</td>
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<tr>
<td>Reading Fluency</td>
<td>11</td>
<td>.43</td>
<td>.29 to .57</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>2</td>
<td>.26</td>
<td>.12 to .40</td>
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</tbody>
</table>

Working Memory
Melby-Lervag & Hulme, 2012

Verbal Ability .13
Word Decoding .13
Arithmetic .07

“There was no convincing evidence of the generalization of working memory training to other skills (nonverbal and verbal ability, inhibitory processes in attention, word decoding, and arithmetic).”
Executive Function

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Predictor Power of Full Executive Function (EF) Scale</th>
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<tbody>
<tr>
<td>Model</td>
<td>$R^2$</td>
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<tr>
<td>Kindergarten reading</td>
<td>0.20</td>
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<tr>
<td>Intelligence, gender</td>
<td>0.23</td>
</tr>
<tr>
<td>Kindergarten mark</td>
<td>Intelligence, gender</td>
</tr>
<tr>
<td>Intelligence, gender, full EF Scale</td>
<td>0.29</td>
</tr>
<tr>
<td>First grade reading</td>
<td>Intelligence, gender, kindergarten reading</td>
</tr>
<tr>
<td>Intelligence, gender, kindergarten mark</td>
<td>Intelligence, gender, kindergarten mark</td>
</tr>
<tr>
<td>First grade mark</td>
<td>Intelligence, gender, kindergarten mark</td>
</tr>
<tr>
<td>Intelligence, gender, kindergarten mark, full EF Scale</td>
<td>0.56</td>
</tr>
</tbody>
</table>

* $p < .001$

Skill-By-Treatment Interaction

- Burns, Coddig, Boice, & Lukito, 2008
- Interventions selected based on student functioning in the specific skill
- Systematically identify and manipulate environmental conditions that are directly related to a problem
- Isolate target skill deficits

Meta-analytic Research for Reading Interventions

- Formative evaluation: .71
- Fuchs & Fuchs (1986)
- Direct instruction: .84
- Explicit reading comprehension instruction: 1.13
- Kavale & Forness (2000)
Grade Level Team Meeting

• Is there a classwide problem?
• Who needs Tier 2?
• Did we miss anyone?
• What should we do for Tier 2?
• Should we go to Tier 3?

Analysis to Action

TIER 2

Category of the problem?
National Reading Panel

- Is phonemic awareness instruction effective in helping children learn to read?
- Reviewed 52 studies of PA instruction.
- Three general outcomes were explored
  - PA tasks such as phoneme manipulation,
  - spelling,
  - and reading tasks such as word reading, pseudoword reading, reading comprehension, oral text reading, reading speed, time to reach a criterion of learning, and miscues

National Reading Panel Results

- PA instruction demonstrated better efficacy over alternative instruction models or no instruction
- Improved PA measures (strong), reading ($d = .53$) and spelling skills
- Teaching one or two PA skills was preferable to teaching three or more
- PA instruction benefited reading comprehension (Ehri et al.).

Means and Ranges of Effect Sizes by Reading Outcome Measure

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Pseudowords</td>
<td>24</td>
<td>.84</td>
<td>.80</td>
<td>-.19</td>
<td>3.60</td>
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<tr>
<td>Words in Isolation</td>
<td>48</td>
<td>.92</td>
<td>.89</td>
<td>-.05</td>
<td>4.33</td>
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<tr>
<td>Contextual Reading</td>
<td>24</td>
<td>.37</td>
<td>.38</td>
<td>-.37</td>
<td>1.18</td>
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</tbody>
</table>
Tier II Interventions

- PALS
- HOSTS
- Read Naturally
- Rewards
- Reading Rockets
- Etc., etc., etc.

Assess 4 NRP Areas

- Phonemic Awareness
  - Phoneme segmentation fluency
- Phonics
  - Nonsense word fluency (WJ Pseudoword)
- Fluency
  - Oral reading fluency (TOSCRF)
- Vocabulary/Comprehension

Category of Problem MN HS

- 9-12 with approximately 1600 students
- 69.2% pass reading
- 9th-10th grade
- 28% low on MAP (~225)
- 45% Low on TOSCRF (~100)
  - 64% low on phonics (~65)
  - 36% acceptable phonics (~36)
Groups

- Randomly assigned to two groups
  - Read 180
  - Targeted (phonics – REWARDS, fluency – Read Naturally, comprehension – Read 180

- Wait list control group

- 20 minutes each day for 13 weeks in addition to reading and study skills

<table>
<thead>
<tr>
<th>Variable</th>
<th>Targeted Interventions</th>
<th>Control</th>
<th>Waitlist Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency Pretest</td>
<td>90.17</td>
<td>89.88</td>
<td>na</td>
</tr>
<tr>
<td>Fluency Posttest</td>
<td>98.33</td>
<td>94.32</td>
<td>Na</td>
</tr>
<tr>
<td>MAP Fall</td>
<td>206.00</td>
<td>211.00</td>
<td>210.37</td>
</tr>
<tr>
<td>MAP Winter</td>
<td>217.21</td>
<td>212.40</td>
<td>212.78</td>
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</tbody>
</table>

ANCOVA for fluency $F (1, 42) = 4.98, p < .05, d = .50$
ANCOVA for MAP $F (2, 74) = 5.84, p < .05$, partial eta squared = .14.

Comparison of Targeted and Comprehensive

- 306 second-grade and 303 third-grade students
- Attended one of six elementary schools in an urban school district
- 51.4% females, 14% white students, and 80% were eligible for the FRPL
- Leveled Literacy Intervention
- PRESS Interventions (comprehension, fluency, decoding, phonemic awareness)
Meta-Analysis

- 24 studies of K-8 small-group reading interventions
  - 26 effects
- Median $g = .50$
- Age
  - K-2 = .66
  - 3-8 = .22
- Targeted (comprehension, fluency, vocabulary, decoding, phonemic awareness)
  - 13 effects, $g = .65$
- Comprehensive
  - 13 effects $g = .26$

Hall & Burns (2013)
ACCURACY > 93% Fluency intervention

Tier III

Causal Variable?

Tier 2 Problem Solving

- Check student’s attendance – Does the student attend school regularly
- Observe the student – Are behavioral difficulties interfering with the interventions?
- Incentivize the intervention – Is the student sufficiently motivated?
- Examine intervention fidelity – Is the intervention occurring as it should?
- Examine the accuracy within skill and GOM data – Are the students receiving a proficiency intervention when they should be focusing on acquisition?
- Compare skill and GOM data – Are students not generalizing (skill data are going up but GOM are not)
Deanna – 2nd Grade

<table>
<thead>
<tr>
<th></th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
<th>Week 9</th>
<th>Slope</th>
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<tbody>
<tr>
<td>GOM</td>
<td>39</td>
<td>40</td>
<td>38</td>
<td>51</td>
<td>32</td>
<td>65</td>
<td>40</td>
<td>40</td>
<td>47</td>
<td>.83</td>
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<tr>
<td>ORF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill</td>
<td>57</td>
<td>45</td>
<td>49</td>
<td>44</td>
<td>55</td>
<td>21</td>
<td>54</td>
<td>63</td>
<td>58</td>
<td>.75</td>
</tr>
</tbody>
</table>

Context of Learning

National Reading Panel

Phonemic Awareness

- Phonics
- Fluency
- Vocabulary
- Comprehension

Berninger et al., 2006

National Reading Panel

Phonemic Awareness

- Phonics
- Fluency
- Vocabulary
- Comprehension

Berninger et al., 2006
Instructional Hierarchy: Stages of Learning

<table>
<thead>
<tr>
<th>Learning Hierarchy</th>
<th>Acquisition</th>
<th>Proficiency</th>
<th>Generalization</th>
<th>Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow and inaccurate</td>
<td>Accurate but slow</td>
<td>Can apply to novel setting</td>
<td>Can use information to solve problems</td>
<td></td>
</tr>
<tr>
<td>Modeling</td>
<td>Novel practice opportunities</td>
<td>Discrimination training</td>
<td>Problem solving</td>
<td></td>
</tr>
<tr>
<td>Explicit instruction</td>
<td>Independent practice</td>
<td>Differentiation training</td>
<td>Simulations</td>
<td></td>
</tr>
<tr>
<td>Immediate corrective feedback</td>
<td>Timings</td>
<td>Immediate feedback</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Accuracy

- Contextual Reading
  - 93% - 97% known material

- Everything Else
  - 90% known

Rate

- Once a student is accurate, the main concern is proficiency which is measured by rate
  - Rate is commonly measured by schools e.g., CBM
- Rate cut points are often based on normative expectations for the skill of concern
  - Rate is also an indicator of when a student moves from the proficiency to the generalization stage
Learning Hierarchy | Phonemic Awareness | Phonics | Fluency
---|---|---|---
Acquisition | Explicit instruction in blending and segmenting (Blackman et al., 2001) | Incremental Rehearsal with letter sounds (Tucker, 1989) | Incremental Rehearsal for words (Burns, 2007)
 | Explicit instruction in letter sounds (Carnine et al., 2004) | Listening passage preview (Rose & Shemy, 1984) | Supported Cloze Reading (Rasinski, 2003)
 |  |  | Phrase drill (O'Shea, Munson, & O'Shea, 1984)
Generalization | Discrimination and differentiation training
Adaption | Problem-solving activities and simulations

- **Acquire**
  - Acquisition rate (less targets per sessions with more intervention sessions)
  - Make stimuli more salient and errorless

- **Retain**
  - Increased repetition within lesson (IR)
  - Increased repetition across lessons (same number of targets with more intervention sessions)
  - Frequent review (same number of intervention sessions, but daily review)

- **Generalize**
  - Integrate a variety of forms of the letters/words, including those similar to how they are presented during assessment into intervention sessions
BEA - Acquire

- Identify enough unknown
- Acquisition rate (less targets per sessions with more intervention sessions)
- Make stimuli more salient and errorless
  - Bigger, color, contextualized (e.g., Zoo Phonics)
- Test – random sequence (two of each conditions)
  Replicate most and least effective

Lonnie

Graph showing IR with Picture Cues and IR with Picture Knowns over time.

Lonnie

Graph showing Correct Letter Sounds (LSC) over time.
Retention Intervention

- Short sessions
- Twice per day
- Test retention at the end of each day
- Start with review
## Effectiveness

<table>
<thead>
<tr>
<th></th>
<th>Pre BEA</th>
<th>Post BEA</th>
<th>Signed Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Letter-Sound Fluency</strong></td>
<td>0.77</td>
<td>2.93</td>
<td>Z = 2.02*</td>
</tr>
<tr>
<td><strong>Oral Reading Fluency</strong></td>
<td>0.25</td>
<td>1.92</td>
<td>Z = 2.67*</td>
</tr>
</tbody>
</table>
## Analysis to Action

**Benchmark Data Worksheet 2nd-6th grade**

**Meeting Date:** ________ **Teacher Name:** __________________________

**Assessment Analyzed:** ____________________ **Class Wide Median:** ______

<table>
<thead>
<tr>
<th>Determine Need:</th>
<th>Action Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Is a Whole Class Intervention necessary?</strong>&lt;br&gt;Yes  No</td>
<td>• Determine appropriate Class Wide Intervention:&lt;br&gt;<strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong>&lt;br&gt;• Determine Start Date:&lt;br&gt;</strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong>&lt;br&gt;• Determine End Date:&lt;br&gt;<strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong><strong>&lt;br&gt;• Schedule Fidelity Check:&lt;br&gt;</strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong></strong>&lt;br&gt;• Progress Monitor Assessment</td>
</tr>
<tr>
<td><strong>Which students fall within the at-risk range?</strong>&lt;br&gt;<strong>Are there any students we missed?</strong></td>
<td><strong>Among students identified as needing a Tier 2 intervention, what is the category of the problem? (phonemic awareness, decoding, fluency, vocabulary, comprehension)</strong>&lt;br&gt;<strong>What intervention do you plan to use to address the problem?</strong></td>
</tr>
<tr>
<td><strong>Student Name:</strong></td>
<td>WRC/Error</td>
</tr>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
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<tr>
<td>4.</td>
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<td>6.</td>
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<tr>
<td>7.</td>
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<tr>
<td>8.</td>
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</table>

**Benchmark Criterion**<br>FALL: _____ WINTER: _____ SPRING: _____