Measuring Mathematical Skills and Knowledge in Preschool

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Introduction

- Importance of assessing early development in mathematics
- Differences in mathematical development between children from high and low SES backgrounds emerge by 3 years of age and increase through the preschool years (Case, Griffin, & Kail, 1999; Stipek & Ryan, 1997, Wright, Marland, & Scharff, 2000).
- Mathematics skills at kindergarten entry are the strongest predictor of later achievement in both reading and mathematics (Duncan et al., 2007).
- Preschool Numeracy Indicators (PNIs)
  - Developed to assess number knowledge and skills of young children over time.
  - Attention to developmental research, strengths and limitations of existing assessments, and unique characteristics of preschoolers.
  - Further attention to characteristics of general outcome measurement (GOM; Fuchs & Deno, 1991) such as ease and efficiency of use, sensitivity to growth over time and instruction and intervention, and the link between the indicator and valued educational outcomes.
- Areas of interest
  - Technical characteristics of the PNI (i.e., reliability and validity)
  - Sensitivity to growth over time in a diverse sample of children.
  - Predictive validity and classification accuracy

Preschool Numeracy Indicators

- Quantity Comparison (QC): “Show me which box has more.”
- One-to-One Correspondence Counting (OOCC): “Count these circles out loud. Put your finger on each one as you count.”
- Oral Counting (OC): “Let’s count. When I tap, Count! I want you to count as high as you can. Start with 1 and do your best counting.”
- Number Naming (NN): “Name each number as fast as you can. Ready? Measure is the number of numbers named correctly in one minute.

Key Questions

1. What is the test-retest reliability of the PNI tasks?
2. What is the concurrent validity of the PNI tasks?

Participants and Setting

- 163 children ages 3 to 6 years old enrolled in four preschool education settings (church-affiliated preschool, university-affiliated preschool, Head Start) in urban mid-South city.
- Diverse in socioeconomic status; Race restricted primarily to Black and White; A small percentage were identified as disabled.

Other Measures

- Bracken Basic Concept Scale-Revised (BBCS-R; Bracken, 1998)
  - School Readiness Composite and Quantity Subtest

Procedures

- Test-retest Reliability
  - Forty-five children from two settings completed all four PNIs across a 2- to 4-week interval.

- External Relations
  - 41 children completed the BBCS-R (Bracken, 1998) and the Applied Problems test from the WJ-III (Woodcock et al., 2005) in counterbalanced order 4 days, on average, after the PNIs.
  - 43 children from one setting completed the TEMA-3 within two days of the PNIs.

Results

Table 1. Test-retest reliability coefficients for the PNIs

<table>
<thead>
<tr>
<th>Measure</th>
<th>PNN Correlation Coefficient</th>
<th>PNN Correlation Coefficient (p &lt; .05)</th>
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</thead>
<tbody>
<tr>
<td>Number Naming</td>
<td>.71</td>
<td>.73</td>
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<tr>
<td>Oral Counting</td>
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<td>.73</td>
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<tr>
<td>One-to-One Counting</td>
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<td>.62</td>
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<tr>
<td>Quantity Comparison</td>
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</table>

Table 2. External relations with criterion measures

<table>
<thead>
<tr>
<th>Measure</th>
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<th>DC Correlation Coefficient (p &lt; .05)</th>
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<tbody>
<tr>
<td>Bracken Basic Conceptual Reasoning</td>
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<tr>
<td>Bracken Quantity</td>
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<tr>
<td>Bracken Applied Problems</td>
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<tr>
<td>TEMA-3</td>
<td>.84</td>
<td>.84</td>
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</tbody>
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Discussion Issues

- Need to expand our measurement construct (i.e., subbing, geometry, patterning/graphics).
- Identify an appropriate measurement schedule, considering how much growth can be expected across programmatic variability.
- Need to consider linguistic diversity and issues in assessment of English Language Learners.
- Need to understand assessment in an RTI context to inform instruction.
- The next generation of PNI, moving into an IRT framework, increasing efficiency and utility.