“Teachers should think:

• that mathematics, their understanding of children’s thinking, and their teaching practices fit together to make sense, and

• that they are capable of learning about mathematics, student mathematical thinking, and their own practice themselves by analyzing what goes on in their classes.”

*Adding It Up*, p. 384
Adaptive Expertise as a Lens

“The development of ‘adaptive expertise’ provides an appropriate gold standard for becoming a professional.”
Darling-Hammond & Bransford, 2005
Preparing Teachers for a Changing World

Routine Experts

• A routinized, fixed knowledge base
• Strengths: efficiency, accuracy, automaticity in solving familiar problems
• Potential weakness: limited flexibility for innovation

Adaptive Experts

• Learning orientation to work, with a flexible, adaptable, growing knowledge base
• Strengths: tendency to explore, learn, and innovate in complex and dynamic situations
• Potential weakness: lack of efficiency
How do we take this intuitively appealing idea and begin to develop it as a construct that can be used in a systematic manner to inform research, teacher practice, teacher education, and policy?
1. Review research literature → working operational framework for AIT

2. Develop an instrument to measure AIT (interview / coding rubrics)

3. Examine research questions about AIT within a teaching population

   - What is the distribution of AIT over the sample?
   - How does AIT relate to other important constructs?
     - Content knowledge
     - Other dispositional constructs
     - Instructional goals
     - Student achievement
     - School context
Overview of Operational Framework for AIT

Dimension 1: Habits of mind

*From motivation theory (e.g., Dweck)*

- Implicit theory of teaching competence (“fixed” vs. “incremental”)
- Tendency to experiment and take on challenges
- Locus of responsibility for student success/failure

Dimension 2: Adaptation and knowledge-building through practice

*From research on student thinking, formative assessment, knowledge building (e.g., Carpenter, Fennema, Franke; Black & Wiliam; Ball)*

- Elicitation of student thinking (what they understand)
- What they do with this information
  - Use it to adjust instruction
  - Use it as part of a deliberate knowledge-building about their own practice
- When they adjust instruction, the breadth of strategies beyond reteaching

Dimension 3: Pursuit/creation of professional learning opportunities

- Self-directedness and purposefulness
Research Design
Participants: Experienced Middle School Math Teachers in High-Poverty Schools

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Number of teachers</td>
<td>36</td>
</tr>
<tr>
<td>Years teaching full time</td>
<td>13.8 (7.6)</td>
</tr>
<tr>
<td>Teacher ethnicity (%)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>8.3</td>
</tr>
<tr>
<td>Hispanic/Latino-Latina</td>
<td>11.1</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>13.9</td>
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<td>White</td>
<td>61.1</td>
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<tr>
<td>Number of schools</td>
<td>21</td>
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<tr>
<td>Mean % qual for lunch</td>
<td>72 (43-99)</td>
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<tr>
<td>Number of students</td>
<td>9,924</td>
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<tr>
<td>Student ethnicity (%)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
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<tr>
<td>Hispanic/Latino-Latina</td>
<td>44.8</td>
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<tr>
<td>Asian/Pacific Islander</td>
<td>17.6</td>
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<tr>
<td>White</td>
<td>19.7</td>
</tr>
<tr>
<td>Native American</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Procedure

All by mail, phone, and web…

- Respond to recruitment flier
- Phone interview (2 hours)
- Written surveys (2 hours)
- Optional web-based learning task
Sources of Data

To investigate AIT

1. In-depth semi-structured phone interview
   Probes each facets of the AIT framework

To examine relationships with other important constructs

2. Assessment of MKT for middle school math
   Based on validated instruments in our prior work; Aligned with
   MS NCTM Focal Points (proportionality & linear function)

3. Questionnaire battery
   Validated instruments probing dispositional constructs and
   aspects of practice

4. Their students’ California Standards Test (CST) scores
   The prior three years, both incoming and outgoing
Measuring AIT
Properties of the Interview Protocol

- 10 “facets” across the 3 dimensions of the operational framework
- For each facet:
  - Block of questions
  - Corresponding 3-level ordinal coding rubric (criteria are very specific)
- All interviews coded by two coders
Properties of AIT as a Scale

• Overall AIT Index (aggregated across the 10 facets)
  – Cronbach’s alpha: .85
  – Inter-rater reliability: .86

• Three dimensions as subscales
  – Reasonable inter-item and inter-rater reliabilities (almost all)
Implicit theory of professional teaching competence as “fixed entity” vs. “subject to incremental growth”

**Fixed (Ludwig)**
I would lean more toward a natural ability, and it has very little to do with content. I think that's more about being a communicator and knowing your audience and having enthusiasm. You can be a very solid teacher without those qualities... but I think that when you [don't] bring that to the table that's hard to learn.

**Growth (Gigi)**
I think teaching is an art. It's also a skill that you practice and you refine and you collaborate with other people. You watch good teachers and you try things out, you learn, you read, you research. That's not natural; that's an actively learning teacher. So I think anybody, if they want to, could learn some good ways to teach students.
Use of information about student thinking to adjust instruction

**Routine (Bonnie)**
Now we have benchmarks so we have to get through that material before the benchmark, so we are required to keep on a certain amount of, you know, pacing...Whether we have everybody with us or lose half the class....And I disagree with that but, you know, can't do anything about it.

**Adaptive (Lolita)**
As I’m watching the kids work in the classroom, I am building the sense of what we need to cover in different ways, of what we need to repeat; what we can possibly just sort of skim through and go on to the next concept because there’s understanding and fluidity in what they’re doing.
Illustrative Quotes
Dimension 3: Pursuit of Professional Development

Self-directedness in pursuing or creating professional learning opportunities

Routine (Dan)
The principal [prompts me to engage in learning opportunities]... She [tells] me, “Hey this is really good. You should go to this” ... Or other colleagues, “Hey, do you want to go to this with me?” ...
Okay. Or you know might be... a monetary motivation you know ... They will come and say, “Hey, we will give you a $1,500 stipend if you come to this class over the summer.”

Adaptive (Lolita)
Well, I am always searching for ways to learn more about how to teach math... how to change my practices to be able to reach more students...I hunger for the opportunities to discuss what we’re doing in the classroom...[There was] a study for English language learners ... I jumped on that because it’s that opportunity to ... work with other colleagues and to grow in my math, as well as in my teaching skills.
AIT Normally Distributed Over the Sample

Mean = 2.1 / SD = .45
Relationships of AIT to Other Variables
The Higher the Adaptiveness, the Higher the MKT

<table>
<thead>
<tr>
<th></th>
<th>AIT</th>
<th>D1 Habits of Mind</th>
<th>D2 Kn’lq Bldg</th>
<th>D3 Pursue PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKT (instrument based on prior work)</td>
<td>.340</td>
<td>.225</td>
<td>.334</td>
<td>.375</td>
</tr>
</tbody>
</table>

Blue cells significant at .05 level or lower

**Note:** There was no math in the interview. What is the direction of causality?
## Adaptiveness Related to Other Established Dispositional Constructs

<table>
<thead>
<tr>
<th>Category</th>
<th>AIT</th>
<th>D1 Habits of Mind</th>
<th>D2 Kn’l’g Bldg</th>
<th>D3 Pursue PD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positively Related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tendency toward curiosity (Kashdan)</td>
<td>.331</td>
<td>.302</td>
<td>.265</td>
<td>.260</td>
</tr>
<tr>
<td>Personal teaching efficacy (Midgeley)</td>
<td>.280</td>
<td>.294</td>
<td>.151</td>
<td>.341</td>
</tr>
<tr>
<td>Incremental theory of intelligence (Dweck)</td>
<td>.253</td>
<td>.263</td>
<td>.042</td>
<td>.402</td>
</tr>
<tr>
<td>Locus of responsibility for student failure lies with the teacher (Guskey)</td>
<td>.550</td>
<td>.531</td>
<td>.450</td>
<td>.408</td>
</tr>
<tr>
<td><strong>Negatively Related</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belief that effort cannot improve teaching ability (Dweck)</td>
<td>-.337</td>
<td>-.431</td>
<td>-.013</td>
<td>-.457</td>
</tr>
<tr>
<td>Belief in how easy it is to diagnosis someone’s intelligence (Dweck)</td>
<td>-.445</td>
<td>-.456</td>
<td>-.302</td>
<td>-.361</td>
</tr>
<tr>
<td>Locus of responsibility for student failure lies with the students (Guskey)</td>
<td>-.456</td>
<td>-.500</td>
<td>-.256</td>
<td>-.404</td>
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<tr>
<td>Performance orientation to teaching (Button)</td>
<td>-.590</td>
<td>-.580</td>
<td>-.481</td>
<td>-.430</td>
</tr>
</tbody>
</table>

Blue cells significant at .05 level or lower / Green at .07 level
The Higher the Adaptiveness, the Less Emphasis on Procedural Fluency / Test Prep

<table>
<thead>
<tr>
<th>Scales from Darling-Hammond et al.</th>
<th>AIT</th>
<th>D1 Habits of Mind</th>
<th>D2 Kn’lg Bldg</th>
<th>D3 Pursue PD</th>
<th>MKT</th>
<th>Math Anxiety (Hopko)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitively complex practices*</td>
<td>.178</td>
<td>.173</td>
<td>.126</td>
<td>.179</td>
<td>-.071</td>
<td>-.435</td>
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<tr>
<td>Procedural fluency (procedures, algorithms, speed, accuracy)</td>
<td>-.379</td>
<td>-.383</td>
<td>-.329</td>
<td>-.301</td>
<td>-.091</td>
<td>-.008</td>
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<tr>
<td>Preparing students for standardized tests</td>
<td>-.538</td>
<td>-.471</td>
<td>-.534</td>
<td>-.397</td>
<td>-.214</td>
<td>.188</td>
</tr>
</tbody>
</table>

Blue cells significant at .05 level or lower

*Practices
- Justification/proof
- Problem-solving
- Communicating mathematical ideas
- Making connections
- Using multiple representations
Preliminary Student Achievement Analysis: Does Adaptiveness Predict CST Scores?

• 3-Level HLM Model (student → year → teacher)
  – AIT significantly predicts CST scores the year before coming into the teacher’s classroom (tracking? Indicator of context?)
  – AIT marginally predicts CST scores the year the student is in the teacher’s classroom

• Needs further investigation
  – What are the directions of causality?
  – What are the mechanisms of influence?
What Is the Role of Context?

• None of the variables we measured were related to AIT…
  – Percent free lunch in the school
  – School API
  – Supportiveness of administration and staff (self-report scale from Darling-Hammond et al.)

• But qualitatively, there were clearly supports and hindrances
Summary

AIT reveals important interactions at the intersections of context and teacher disposition, learning, knowledge, and practice.

• AIT reveals qualitatively different habits of mind, teaching practices, and approaches to PD
• AIT is somewhat normally distributed over the sample
• AIT has relationships to important educational factors…

Higher Routineness
• Greater instructional emphasis on procedural fluency and test prep
• Greater belief that effort cannot improve teaching
• Greater belief that it is easy to diagnose intelligence
• Performance orientation to teaching
• Locus of responsibility with students

Higher Adaptiveness
• Higher MKT
• Higher tracking, possibly higher student achievement (preliminary)
• Higher curiosity
• Higher self-efficacy
• Incremental theory of intelligence
• Locus of responsibility with teacher
Future Directions

• By what mechanisms might adaptiveness be associated with higher student achievement?
  – Observe actual classroom practices
  – More proximal measures of student learning and engagement
  – Examine more closely MKT ↔ adaptiveness link

• What is the role of context?
  – What supports and hinders adaptiveness?
  – Contrast with high SES contexts

• How can we build on the strengths of the vast number of teachers who are more routine-oriented?

• What does adaptiveness look like in early-career teaching?

• What are potential impacts of interventions to shift dispositional factors? Some research-based interventions in psychology shown to shift potentially relevant factors…
  – Curiosity (e.g., Kashdan)
  – Attribution style (e.g., Seligman)
  – Theory of intelligence (e.g., Dweck)
Thank you for your attention.

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