



## Preschool Mathematical Practices

### Learning to Make Sense and Persevere


Presenters: Kristen E. Reed & Deborah B. Spencer  
Education Development Center, Inc.

Pls: Jessica Mercer Young & Kristen E. Reed, EDC


## Agenda

- The research project
- Persistence in early childhood
- Growth mindset in early childhood
- The mathematics games
- Discuss how games foster: mathematics learning, SMP 1, persistence, and growth mindset




## Games for Young Mathematicians Project

- Working with 4 Head Start programs
- 6 Teacher PD sessions
  - SMP1: Make sense of problems and persevere in solving them
  - 5 preschool mathematics games/activities
  - Persistence
  - Growth mindset
- Pre/post assessments on children's mathematics and persistence



## Persistence in Developmental Psychology

- Children's learning is fostered by their innate curiosity and desire to master new and challenging tasks
- *Mastery motivation* is a child's independent persistence to accomplish moderately challenging tasks
- Children's level of mastery motivation is affected by their socializing environment




## Malleability of Mastery Motivation

Research has found children's mastery motivation increases with:


- Problem-posing toys
- Caregiver warmth and positive interactions
- Caregiver scaffolding, not controlling, children's behavior when engaged in a challenging task

Barrett, Morgan, and Maslin-Cole, 1993; Busch-Rossnagel et al., 1995; Kelley, Brownell, and Campbell, 2000; Moorman and Pomerantz, 2008; Young and Hauser-Cram, 2006



## Persistence and Academic Success

- Kindergarteners with more persistence did better in the classroom and were rated by teachers as having stronger math and reading skills (Berhenke, Miller, Brown, Seifer, and Dickstein, 2011)
- Preschooler's differences in mastery motivation accounted for differences in their academic gains even after controlling for prior achievement (Turner & Johnson, 2003)




## Games for Young Mathematicians Research Study Hypothesis

A teacher professional development intervention that...

- shows teachers challenging mathematics activities
- supports teacher/child interactions that scaffold persistence (mastery motivation)
- develops 'growth mindset' beliefs about learning

...will influence children's mastery motivation and mathematics learning.




## Beliefs About Intelligence

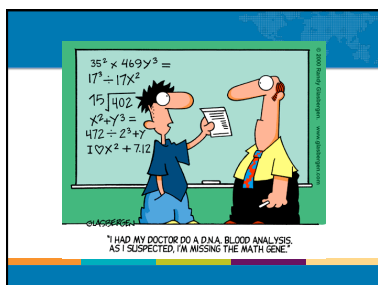
FIXED MINDSET	GROWTH MINDSET
<b>Intelligence is static</b>	<b>Intelligence can be developed</b>
Leads to a desire to look smart and therefore a tendency to	Leads to a desire to learn and therefore a tendency to
<ul style="list-style-type: none"> <li>• Avoid challenges</li> <li>• Give up easily due to obstacles</li> <li>• See effort as fruitless</li> <li>• Ignore useful feedback</li> <li>• Be threatened by others' success</li> </ul>	<ul style="list-style-type: none"> <li>• Embrace challenges</li> <li>• Persist despite obstacles</li> <li>• See effort as path to mastery</li> <li>• Learn from criticism</li> <li>• Be inspired by others' success</li> </ul>



## Why Mindsets Are Important

- Dweck (2006) showed that children's theories of intelligence predicted which learning goals they would tend to pursue.
- Children with a growth mindset pursued *learning goals* where the goal of an activity was to improve their abilities—they persisted longer at challenging tasks and preferred challenge.
- Children with a fixed mindset pursued *performance goals* and chose an easier task where they were more likely to be successful.





### Teachers' Beliefs About Intelligence

- There is less research available on teachers' theories of intelligence and how they affect students' achievement.
- Teachers' judgments of their students' intelligence influenced students' perspectives of their own intelligence *and* their judgments of their peers' intelligence (Pretzlik, Olsson, Nabucco, and Cruz, 2003)
- Falko Rheinberg in Germany has shown that when teachers believe they have an impact on their students' intelligence, many students who were previously low achievers blossom in their classes.

### Growth Mindset in the PD

- Your brain changes throughout your life.
- The brain is like a muscle—the more you exercise it, the stronger it becomes.
- When you try hard and learn something new, your brain forms new connections that, over time, make you smarter.
- Intellectual development is the formation of new neural connections brought about through effort and learning.
- How we praise children impacts their mindset.

### Teacher Child Interaction: Process praise vs. person praise

- Process Praise
  - “You worked really hard on that”
  - “You tried different strategies to figure out what worked”
- Person Praise
  - “You are really good at that”
  - “You are really smart”

### Effects of Praise

- Praising children for their effort (process)
  - embraced challenges,
  - maintained confidence in the face of difficulty,
  - maintained their motivation, and
  - showed enhanced performance after difficulty.
- Praising children for their intelligence (person praise)
  - cared more about looking smart than about learning
  - lost confidence in their abilities when a task became difficult
  - impaired motivation and performance after difficulty
  - led them to lie about their performance afterward.

See Mueller & Dweck, 1998

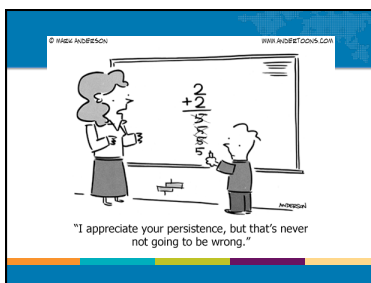
### Effects of Praise

- Recent study of parents and toddlers found that parents who used more process praise at ages 1,2,3- had children who at ages 7 and 8 were more likely to welcome challenges, had strategies for overcoming failure, and thought intelligence and personality were malleable (growth mindset) five years later (Gunderson and Levine, 2013).
- In addition, they found that boys heard more process praise and girls heard more person praise.
- Research suggests that **girls are more likely than boys to have a fixed mindset** (Lloyd, Walsh, & Yallagh, 2005).

### Common Core

*Standard for Mathematical Practice 1: Make sense of problems and persevere in solving them.*

- Look for entry points
- Plan a pathway rather than just jump into an attempt
- Consider analogous problems
- Monitor and evaluate progress
- Change course if necessary
- Continually ask, “Does this make sense?”



### Preschool Mathematics

- Number concepts & quantities
- Number relationships & operations
- Geometry & spatial sense
- Patterns
- Measurement & Comparison

Head Start Child Development and Early Learning Framework (2011)

### Games

- How Many Dots?/How Many Dots Are Hidden?
- Two Numbers
- Numeric Board Game
- Pattern Block Designs & Attribute “Uno” Game
- What is My Pattern?

Pre school Mathematics Practices 400-010

### How Many Dots?

- Uses one-to-one counting
- Recites numbers in correct order (0-10)
- Identifies number of objects without counting to determine quantity (subitizing)
- Uses the number name of the last object counted to represent the number of objects in the set (cardinality)
- Recognizes that numbers (or sets of objects) can be combined or separated to make another number through grouping of objects

Pre school Mathematics Practices 400-010

### Play *How Many Dots?* Intro Game

**Object:** Count and cover the dots on the card.

**How to Play:**

1. Cover the dots with a token as you count them one by one.
2. Say how many dots there are.

**Support:** “When you count, the *last* word you say tells you how many things there are.”

Pre school Mathematics Practices 400-010

### Video *How Many Dots?*



Pre school Mathematics Practices 400-010

### Play *How Many Are Hiding?*

**Object:** Figure out how many tokens the teacher hid.

**How to Play:**

1. Put down several tokens. Children count how many there are in all and say it out loud.
2. Teacher hides some tokens. Children figure out how many are hiding.

Pre school Mathematics Practices 400-010

### Video *How Many Are Hiding?*



Pre school Mathematics Practices 400-010

### Two Numbers

- Recognizes numerals 1-5
- Places number/dot cards in correct order (1-5)
- Uses one-to-one counting
- Identifies number of objects without counting to determine quantity (subitizing)
- Recognizes that numbers (or sets of objects) can be combined or separated to make another number through grouping of objects
- Identifies the new number created when numbers are combined or separated

Pre school Mathematics Practices 400-010

### Play *Two Numbers*


**Object:** Roll dice to turn over all your cards 1 through 5; or 1 through 10 or 12

**How To Play:**

1. Arrange all of your number cards in order.
2. Take turns rolling the number cubes. Say the numbers on the cubes.
3. Turn over the exact numbers you see *OR* add the two numbers and turn over the sum

Pre school Mathematics Practices 400-010

### Video of *Two Numbers*



Pre school Mathematics Practices 400-010

### Numeric Board Game: *Jumping on the Lily Pads*

- Recognize and name written numerals
- Recites numbers in the correct order
- Understand numbers come “before” or “after” one another counting up to and back from 10.
- Uses one-to-one counting
- Identifies 1-dot as 1 and 3-dots as 3 without counting (subitizing)
- Counting on from a number rather than counting the number of spaces moved

Pre school Mathematics Practices

MS-012

### Play *Jumping on the Lily Pads*

**Object:** Reach the Number 10 space

**How To Play:**

1. Roll the number cube and say the number.
2. Move the game piece that number of spaces *while saying the number on the spaces.*

**Variations:**

1. Choose to move forward or backward on the board to land exactly on 5 then exactly on 10, then get back to start.

\*Numeric Board Game is based on work by Dr. Geetha Ramani.

Pre school Mathematics Practices

MS-012

### Video *Jumping on the Lily Pads*



Pre school Mathematics Practices

MS-012

### Questions

- Kristen Reed, [kreed@edc.org](mailto:kreed@edc.org)
- Deborah Spencer, [dspencer@edc.org](mailto:dspencer@edc.org)

Pre school Mathematics Practices

MS-012