Emotion and Learning
Examining math anxiety as a case study

Cristina Post, EdM, ET
www.affectacademics.com
Universal Design for Learning

**Recognition Networks**
The "what" of learning

- How we gather facts and categorize what we see, hear, and read. Identifying letters, words, or an author's style are recognition tasks.

**Strategic Networks**
The "how" of learning

- Planning and performing tasks. How we organize and express our ideas. Writing an essay or solving a math problem are strategic tasks.

**Affective Networks**
The "why" of learning

- How learners get engaged and stay motivated. How they are challenged, excited, or interested. These are affective dimensions.

udlcenter.org, cast.org
Three primary principles guide UDL—and provide structure for the Guidelines:

To learn more, click on one of the Guidelines below.

I. Provide Multiple Means of Representation
   - Perception
   - Language, expressions, and symbols
   - Comprehension

II. Provide Multiple Means of Action and Expression
   - Physical action
   - Expression and communication
   - Executive function

III. Provide Multiple Means of Engagement
   - Recruiting interest
   - Sustaining effort and persistence
   - Self-regulation

UDL Guidelines
http://www.udlcenter.org/aboutudl/udlguidelines
Research in Affective Neuroscience

- Learning, attention, memory, decision making, and social functioning are all controlled by emotion.
- People whose emotional centers are damaged cannot make “rational” decisions.

Immordino-Yang and Damasio, 2007
Recruiting interest
(Guideline 7)

- Optimize individual choice and autonomy
  - Giving students control over even a very small aspect of the assignment increases engagement

- Optimize relevance, value, and authenticity
  - Real world problems, as interdisciplinary as possible

- Minimize threats and distractions
  - Vary the level of risk, social demand, and sensory stimulation
  - Math anxiety and stereotype threat are significant

http://www.udlcenter.org/aboutudl/udlguidelines/principle3
What is Math Anxiety?

- State anxiety (vs. trait anxiety) only present when doing math
- Different components of math anxiety:
  - Affective - general fear of or dislike of math
  - Social/performance - board work in front of class, small group work with peers
  - Test anxiety
- Math Anxiety Rating Scales
Anxiety vs. Threat

- Math Anxiety: Decreased performance stems from conscious worry over an expectation of high performance level.
- Stereotype Threat: Decreased performance due to unconscious negative effects from an expectation of low performance level.
Ages of Onset

- 93% of American adults self-identify as being bad at or disliking math

- Three major ages of anxiety onset (Hembree, 1990):
  - Grades 1-3 are more likely to present with stereotype threat (Beilock et al, 2010)
Mirror Neurons and Math

- Both math anxiety and stereotype threat are largely due to modeled behavior by parents and teachers
  - Mirror neurons and emotional alignment
    - Body posture, eye movements, facial expression
  - Not attributable to math content
- Math anxious teachers spend less time preparing for math classes, less time teaching it
  - Teach skills instead of concepts
  - Model math avoidance
The learning brain
Working Memory

Central Executive

Phonological Loop

Episodic Buffer

Visuo-spatial sketchpad

Long term Memory

Adapted from Baddeley, 2010
Working Memory and Math

• Working memory is taxed by mental arithmetic: carrying, borrowing

• Highly anxious people do worse on tasks that require working memory capacity

• Controlling for anxiety and taxing working memory reveals the same effect

• WM is NOT involved in rote memory tasks like retrieving simple math facts

(Ashcraft, 2002)
8 + 3
38 + 49
26 + 57
48 + 65
Why intervene?

- 78% of job growth is in STEM fields
- Accountability (Ashcraft & Moore, 2009): after anxiety onset in 4-5th grade, standardized tests are no longer an accurate measure of math ability
- Remediation of math anxiety is associated with over a twenty percentile point gain on standardized tests (Ma, 1999)
Prevention
Pre-K – Grade 3

- Reduce math anxiety in teachers
  - Preservice teacher training – confidence and awareness
  - Mentoring and support from experienced teachers

- Teaching techniques for positive emotion
  - Storytelling

- Games and Manipulatives
  - Number Worlds Curriculum

- Growth mindset language and mindfulness education as part of the school culture
Prevention and Intervention
Grades 4 – 12

- Mindfulness training
  - Two seconds of silence to clear working memory
  - Recognizing emotions and letting them pass without judgment

- Start with traditional transmission style teaching before beginning more unfamiliar techniques

- Cognitive restructuring and growth mindset
  - Catch negative statements about math and rephrase them, have the student practice
    - The power of YET
  - Support post-exam appraisals: how to think about bad/good grades to support a growth mindset
  - Mistakes as positives
Prevention and Intervention
Grades 4 – 12

- Teachers as counselors and students as mentors
  - Be careful with consoling language!
  - Use growth mindset language

- Convert feelings of anxiety from threat to challenge

- Reduce the threat level
  - Untimed or alternative assessments whenever possible
  - “Imagine yourself as a white male”

- Educational therapy or talk therapy/CBT

- Values Affirmation intervention for stereotype threat
  - Opportunity for collaboration!
Opportunities for Collaboration

- Values Affirmation intervention is best launched by English teachers
- History classes can pose math problems in context
- Art teachers can dispel the “left-brained” myth and reveal the math hidden within art
- All humanities teachers can model positive language around math teaching
  - “not a math person”
- Elementary school teachers can model anxiety-free math learning
  - Relearn math from the ground up
UDL Math Techniques

- Harness positive emotion whenever and however possible
  - Personal connections with students, teaching through games
  - Growth Mindset Language!!!

- Allow for choice whenever possible
  - Two columns of math problems of equal difficulty
  - Choices between tasks (when appropriate)

- Scaffold the level of challenge for individual learning goals
  - Different rubrics for the same task
  - Different tasks depending on individual need

- Ensure that group work is cooperative, not competitive
  - Offer the choice of individual work
  - Guidelines with clear roles and responsibilities
  - Rubrics for social behavior as well as academic work
Math Anxiety Resources


References


