

Addressing Affects in Math Instruction:

What They Are and What Can Be Done About Them

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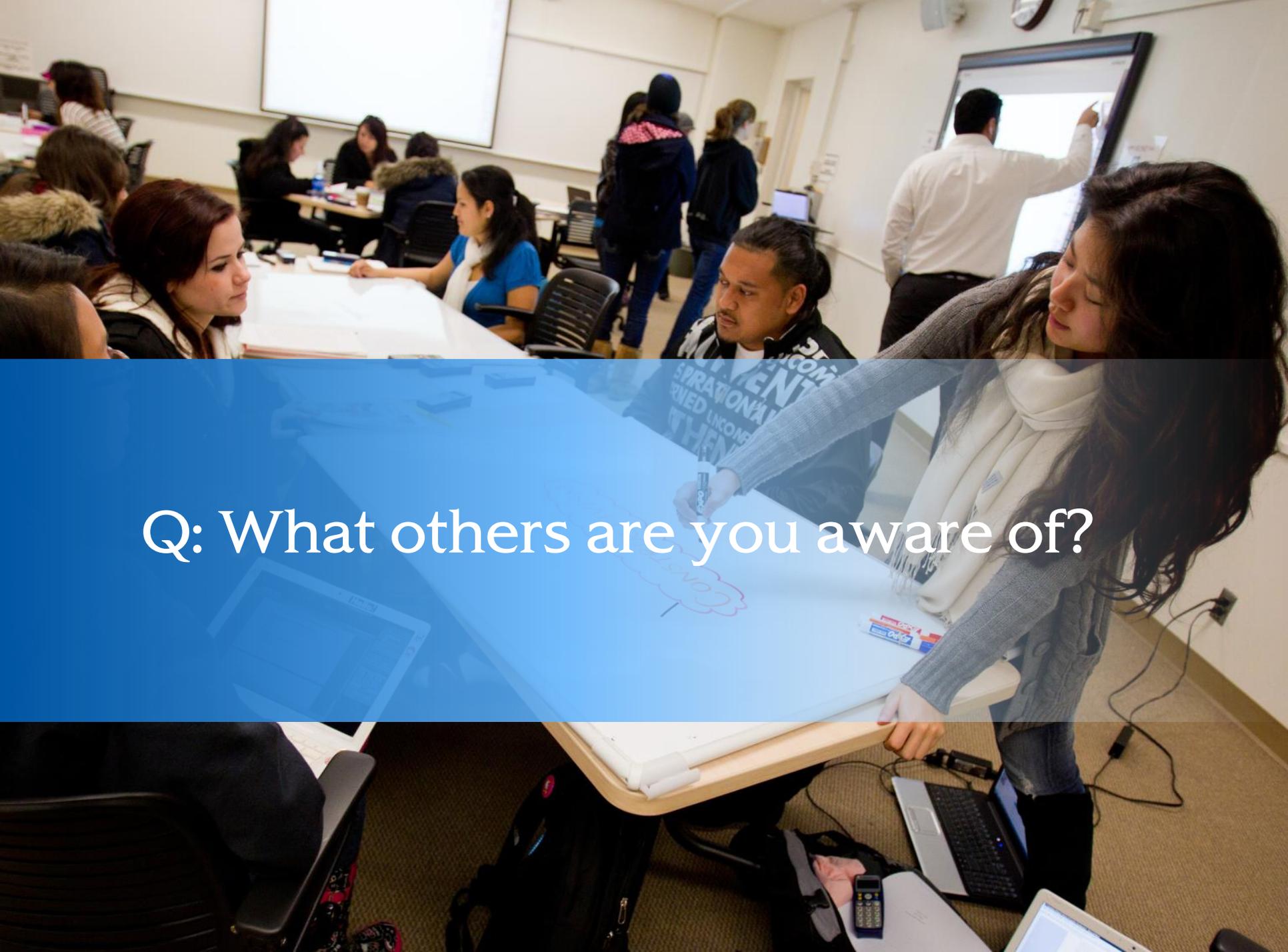
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Part 1: What is *affect*?

Affects

- *Affects* are emotions and mental states that interact with cognition
 - Ex: anxiety may inhibit ability (Hembree, 1990); low interest may lower motivation; etc.
 - Mathematics anxiety triggers the brain's pain centers (Lyons and Beilock, 2012)
- There are a variety of affects:
 - Anxiety, confidence, motivation, interest ... and so many more!
 - Each is difficult to define precisely
- Some cognitive dispositions may regulate affect
 - “growth mindset” (Dweck, 2006; Boaler, 2016), “grit” (Duckworth, 2016)
- Seldom, if ever, are individual affects isolated
 - Many interact to create behaviors of avoidance or engagement



Q: What others are you aware of?

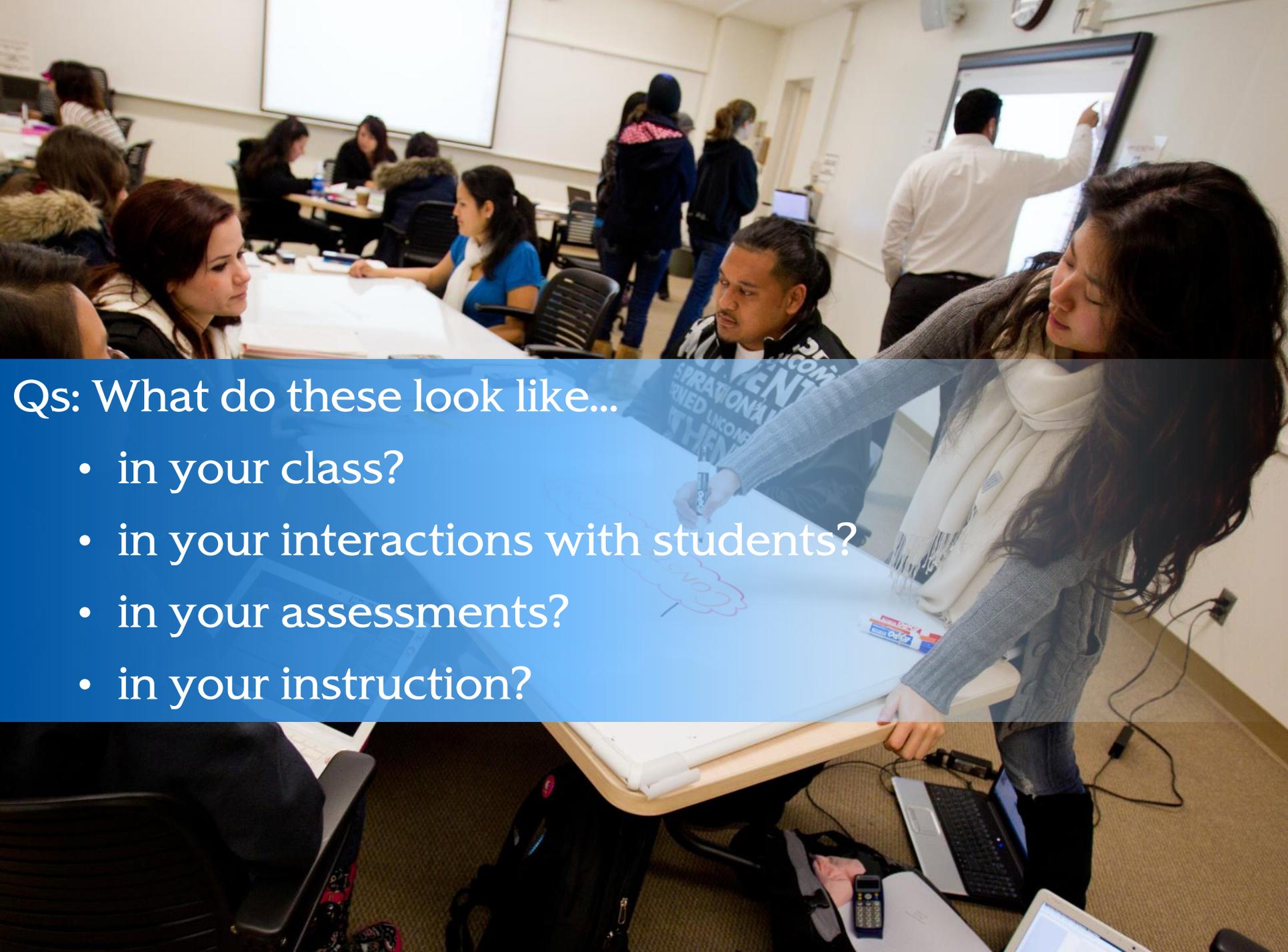


Part 2: Does affect matter?

Do Affects Matter?

- No, not really:
 - *Attitudes towards mathematics* has a weak effect on achievement (Ma and Kishor, 1997)
 - Neutral results may stem from the difficulty in specifying individual affects (Hannula, 2006)
- Yes:
 - Many positive results on affect and aspects of achievement.
 - At SJSU: *confidence* is a leading predictor of developmental math enrolment (Maciejewski and Tortora, *under review*)

MAPS Category	<i>p</i> -value	Odds ratio
Nature of Answers	< 0.01	3.23
<i>Confidence</i>	< 0.001	2.88
Real World Rel.	0.01	1.82



Qs: What do these look like...

- in your class?
- in your interactions with students?
- in your assessments?
- in your instruction?



Part 3: How might we identify affects?

Identifying Affects?

There are a number of methods/tools/frameworks:

- Quantitative, survey-based
 - The Mathematics Attitudes and Perceptions Survey (MAPS; Code, et al., 2016)
 - Assesses students on: confidence, growth mindset, seeing connections to the “real world”, interest, persistence, sense making, and the nature of answers.
 - Anxiety Scales
 - Many. Ex: Abbreviated Math Anxiety Scale (AMAS; Hopko, et al., 2003)
- Qualitative frameworks
 - Three-Dimensional model of Mathematical Attitude (TMA; Di Martino and Zan, 2010)
 - Considers *attitude* as having dimensions:
 - *emotional*
 - *vision of mathematics*
 - *perceived competence*

Sample MAPS Items

Interest:

- “I avoid solving math problems when possible”

Confidence:

- “No matter how much I prepare, I am still not confident when taking math tests.”

Persistence:

- “If I don’t remember a particular formula needed to solve a problem on a math exam, there’s nothing much I can do to come up with it”

An Example of Identifying Affects

Summer Bridge program at SJSU

- Partly intended to address students' relationships with mathematics; managing affect, in particular.
- First: how might affect be identified?
 - Pre-post design. All students:
 - responded to the MAPS
 - wrote essays; "Please describe a personal experience you have had with mathematics"
 - MAPS data can reveal changes on the MAPS categories
 - Essay analysis (using TMA) can reveal more nuanced changes
- Sample essay:

"I've never been good with math. If I do learn something, I usually forget it not too long after. I almost always have a hard time understanding math or even just the point to all the extra formulas or ideas about it. Also since I get really mad and irritated easily when I don't understand a problem it doesn't help me or anyone else."
- TMA: negative emotion; instrumental vision; low competence



Q: How might you identify affects?



Part 4: What can be done?

What Can Be Done?

- Not so much clear guidance in this area...
 - But many local innovations, and much practitioner knowledge to draw on!
- Address affects outright:
 - Dana Centre & Carnegie Foundation
 - SJSU's Summer Program
- Structure your instruction to alleviate negative affects and foster positive affects
 - *Infuse* your instruction and assessment with positive messages of growth; make being wrong a natural, comfortable state
 - *Low confidence* will be addressed at SJSU by creating courses that the students have never seen before

An Example

Summer Bridge program at SJSU

- Four weeks:
 - Week 1
 - Pre-reading: “Differential effects of self-statements following a self-esteem threatening situation”
 - Material: Anxiety, positive attitude, self-esteem/confidence and performance
 - Homework: Positive statement exercise
 - Week 2
 - Pre-reading: “Stereotypes and the achievement gap: stereotype threat prior to test taking”
 - Material: Stereotype threat and performance; changing the way we think
 - Homework: Thought logs
 - Week 3
 - Pre-reading: “A simple visualization exercise for reducing test anxiety and improving performance on difficult math tests.”
 - Material: Mind full vs. mindfulness; relaxation and meditation tools
 - Homework: Mindfulness exercises
 - Week 4
 - Pre-reading: “Promoting healthy transition to college through mindfulness training with first-year college students: pilot randomized control trial”
 - Material: positive thinking & statements; mastering relaxation skills
 - Post-session assessment

Another Example

Mathematical Reasoning course at SJSU

Class 2: 08/27/2018:

1. Set a timer on your cell phone.
2. Search the internet to see how much money one of the richest people in the world made last year or the year before. Who did you find, and how much money did they make?
3. Stop the timer.
4. How much money did the person make in the amount of time that it took you to research them?
5. How much do you get paid in your current job, or if you're not currently work, in a former job?
6. How much would you have to work to make as much as the CEO you researched above did in the time it took you to research them?
7. What assumptions did you make as you completed each of the steps above?



Q: What might you do?



Part 5: How do you know if your course is making a difference?

Assessing your course

- Design a local study!
 - Choose a methodology and framework that identifies what you're interested in and monitors it appropriately
 - For example: pre/post MAPS survey; pre/post Essay writing
 - Avoid common traps!
 - Ex. don't compare pre-post Likert averages!
- Share your results!
 - Consider distributing what you're going to do, what you've done, and what you've discovered with the CSU community, and more broadly
 - Again, choose a rigorous methodology: This can lead to generalizable results

An Example

Summer Bridge program at SJSU

- MAPS comparison
 - (no statistically significant change)
- Essay comparison

	Pos./rel./high		Neg./ins./low		N/a	
	Start	End	Start	End	Start	End
Emotion	30	44	49	41	37	31
Vision	10	12	63	53	43	51
Competence	32	53	76	56	8	7

The statistics:

- Significant changes, pre/post, in students' competence ($p < 0.01$) and emotional scores ($p = 0.04$) as revealed by a TMA analysis of the students' writing.



Q: How will *you* know your course is making a difference?



Conclusion

Summary

- Affect matters
 - Affect may affect learning and performance in mathematics
 - *Confidence* is particularly indicative of enrollment in developmental math.
- Affect is often difficult to define and identify
 - Research literature exists on affect and offers some guidance on how identify it.
 - MAPS; TMA framework
- Something can and should be done
 - Little guidance here; share what you come up with!
 - Address issues outright and early on; Summer Bridge program.
- See if what you are doing makes a difference
 - See issues above
 - Good study design and methods can help further our understanding – share your findings!



Thanks! Questions?
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