

# Mindset Matters

*Exploring Mindset, Grit & STEM Attitudes in CS and Engineering students*

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# Program Overview

- 5 year NSF S-STEM award to support student retention & success
- Scholarships for Undergraduates with a Project Work Studio & research expectation



# Program Rationale

- Women represent only 24% of the computing workforce and 12% of engineers [1,2].
- Non-cognitive skills play a critical role in STEM persistence.
- Research suggests that a growth positively correlates with academic success and resilience in STEM [3-5].
- Grit predicts degree completion even more strongly than IQ [6,7].
- Perseverance may increase over time, passion for STEM can decline, raising concerns about sustaining student engagement in rigorous fields.





# Terms

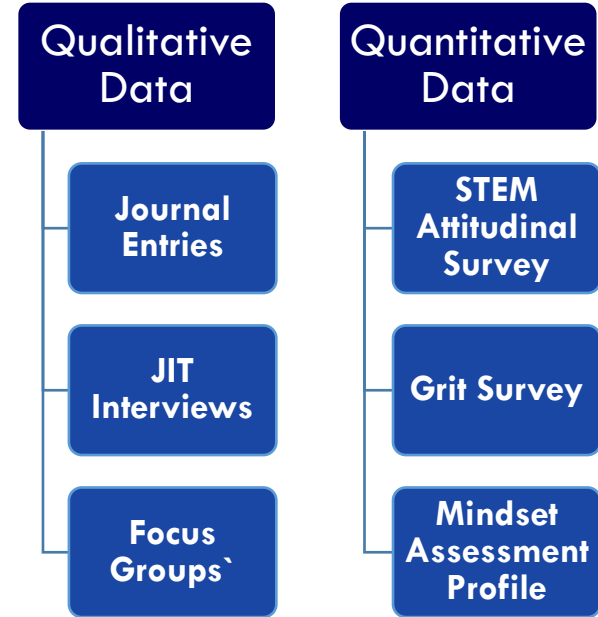
- **Mindset** – our belief that our intelligence is fixed / unchangeable (fixed mindset) or malleable/ changeable (growth mindset) [3]
- **Grit** – an individual's perseverance and passion for longer-term goals and is a better predictor of educational outcomes and success over traditional measurements like IQ [4]



# Research Study

## Participants & Methodology

- (F21, F22) 2 cohorts (N=19) began as incoming freshman
- First-generation, Pell-eligible, and underrepresented students in STEM
- Discipline faculty mentors



# Research Questions

**RQ1** What is the relationship between mindset/grit and STEM retention/success? And how do students describe their mindset/grit when they face academic challenges?

**RQ2** What is the relationship between their mindset/grit and reason for leaving the program? And what reasons do students provide for leaving the program?



# Analysis



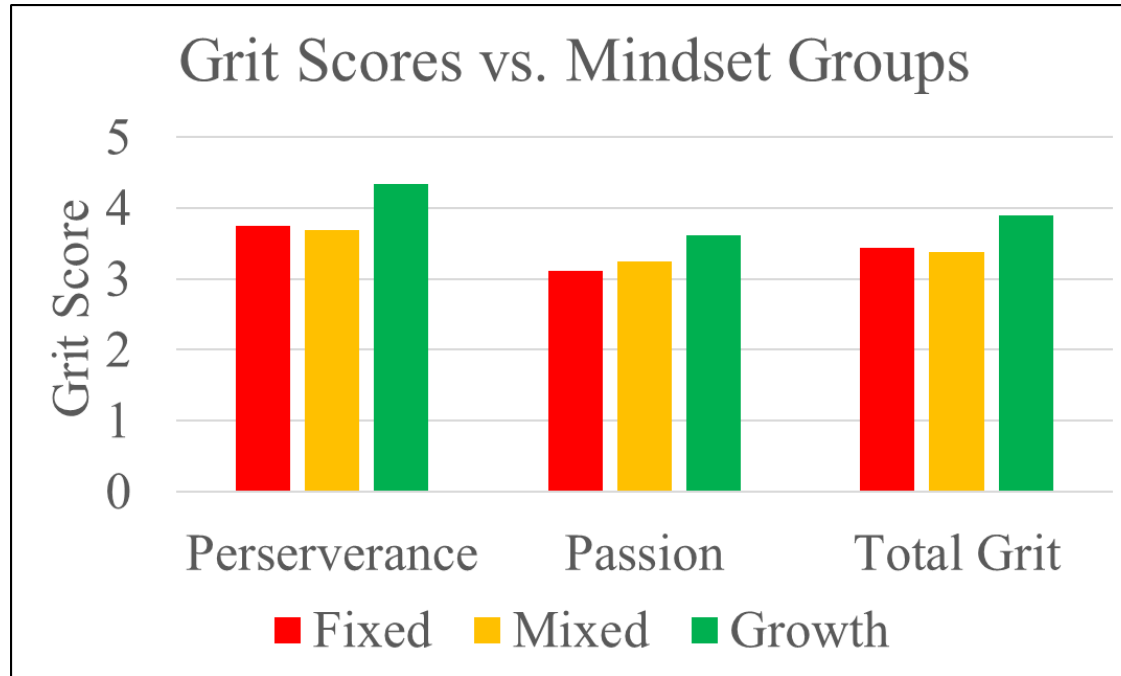
# Mindset Results

- 1) **Fixed** mindset (scores < 24) (N=5),
- 2) **Mixed** mindset (25 < scores < 32) (N=9),
- 3) **Growth** mindset (scores > 32) (N=6).



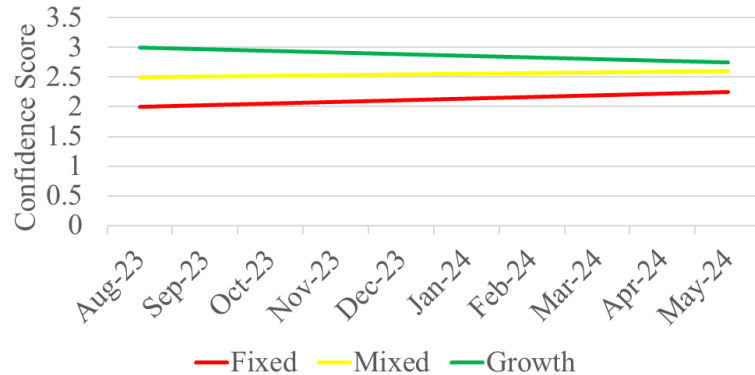


# RQ1: Relationship



# RQ1: Confidence in Major

Confidence in Major over Time



## Comments about their Major over time

### MIXED

Fall 23

*I know this is what I should be doing and I'm happy I chose BME.*



Spr 24

*I have felt a little regret about my major but I'm in it too far to go do anything else so I'm sticking it out.*

### GROWTH

*I am struggling a little in math and physics but I should be okay because I have a good work ethic.*



*I feel like I am doing well in my classes. I really like everything that I am learning about.*

### FIXED

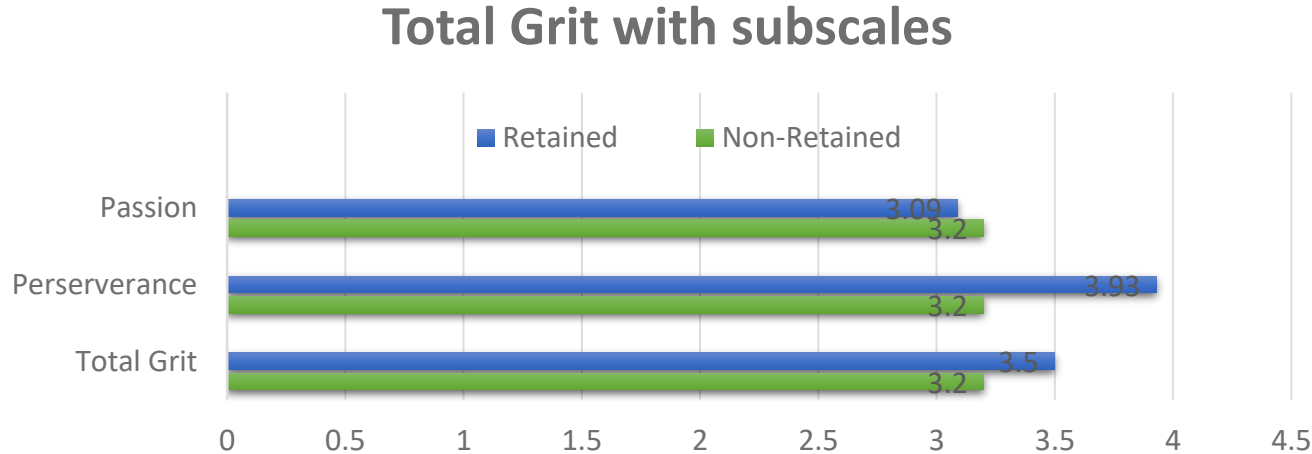
*I feel good about the major, it is just rough*



*I'm not as worried about the degree, but more worried about GPA coming out of it.*



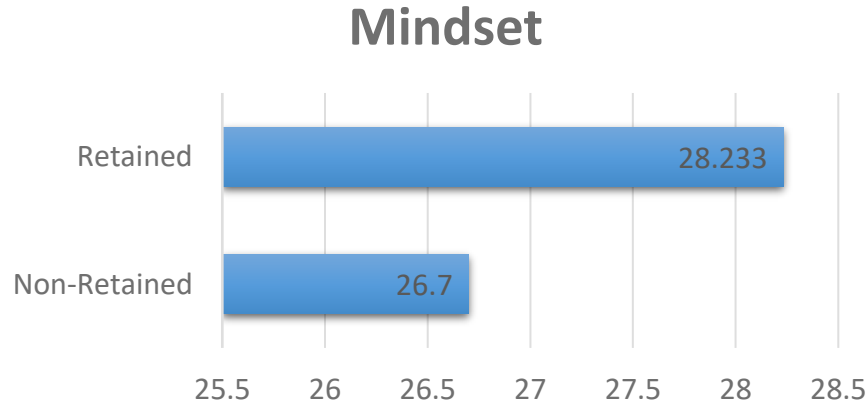
# RQ2: Attrition: Retained vs. Non-Retained



Perseverance subscale notably higher in retained



# RQ2: Attrition: Retained vs. Non-Retained



Retained had more growth mindset



# Faculty Mentorship & Support

## Faculty Mentorship Matters

- Faculty guidance and mentorship in sustaining motivation was emphasized.
  - *"My mentor has helped me with research, career advice, and class struggles. Without that, I might not still be in the program."*
- VS.
- *"I wish we had more structured support in some of the harder courses."*



# Summary of Findings

## Grit and Mindset are Important

- Growth mindset = higher engagement, perseverance, and academic persistence.
- ↑ Perseverance despite ↓ passion aligns with research on academic burnout and the difficulty of sustaining enthusiasm in rigorous fields.
- Growth mindset = more positive attitudes toward mathematics.
- ↑ Mindset scores reported that mentorship and structured academic support helped them persist.
- Non-retained students cited overwhelming coursework and limited access to academic resources as primary challenges.





# References

- [1] Stella Fayer, Alan Lacey, and Audrey Watson, "STEM Occupations: Past, Present, And Future," U.S. Bureau of Labor Statistic, January 2017.
- [2] Computerscience.org, "The Current State of Women in Computer Science," 2020, retrieved from <https://www.computerscience.org/resources/women-in-computer-science/>.
- [3] Dweck, C. S. (2000). Self-theories: Their role in motivation, personality and development. Philadelphia, PA: Taylor & Francis/Psychology Press.
- [4] Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, 78(1), 246–263. doi: 10.1111/j.14678624.2007.00995.x
- [5] Dweck, C. S. (2013). Self-theories: Their role in motivation, personality, and development. Psychology Press.
- [6] Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92(6), 1087. <https://doi.org/10.1037/0022-3514.92.6.1087>
- [7] Duckworth, A., & Gross, J. J. (2014). Self-control and grit: Related but separable determinants of success. *Current Directions in Psychological Science*, 23(5), 319-325. <https://doi.org/10.1177/0963721414541462>.

