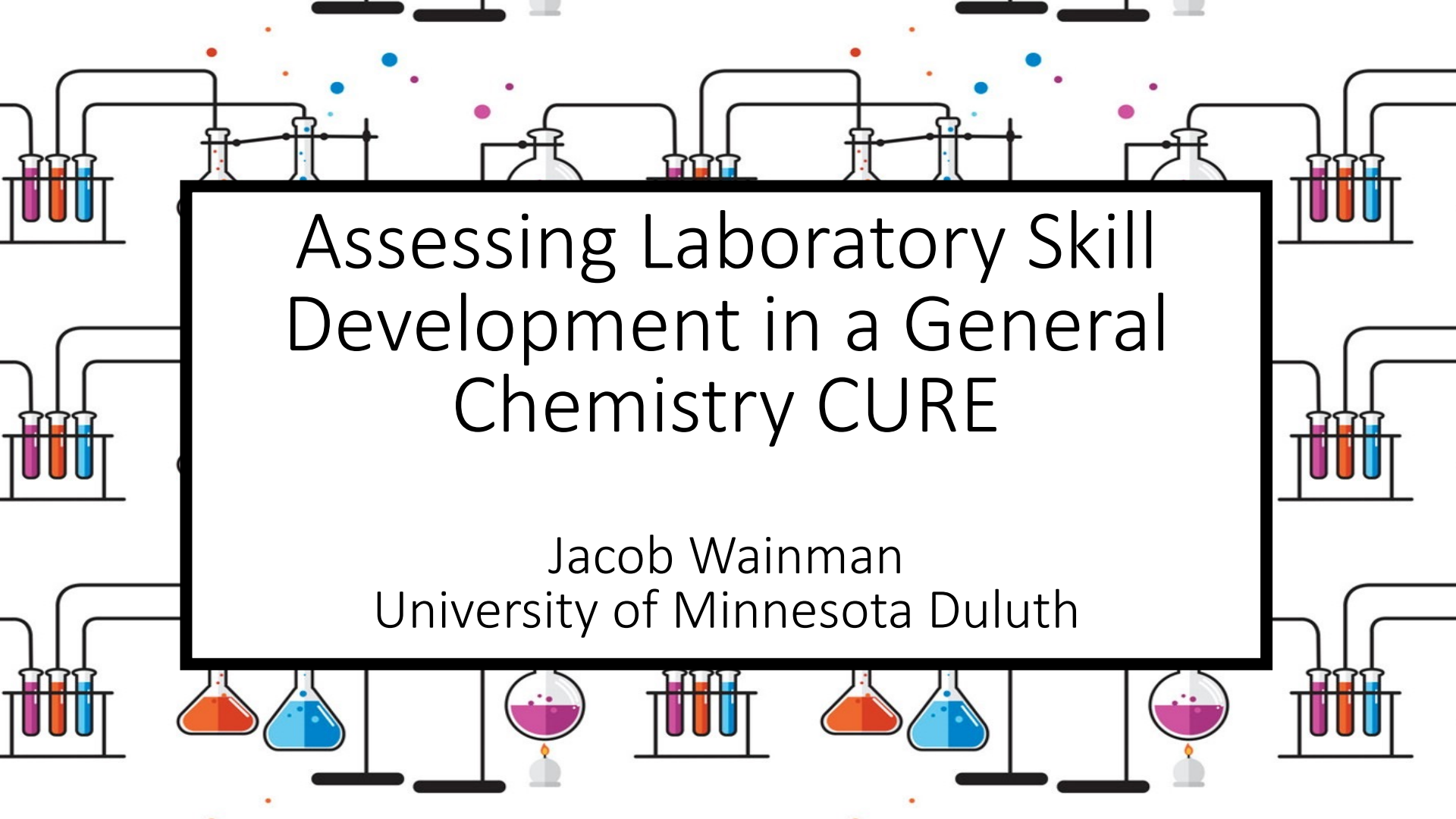


Assessing Laboratory Skill Development in a General Chemistry CURE

Jacob Wainman
University of Minnesota Duluth

What is a Course-Based Undergraduate Research Experience (CURE)?

Components	Traditional	CURE
Results are unknown to the students, instructor, and science community		
Uses science practices		
Iteration - troubleshooting issues, reproducibility		
Collaboration between students, teaching team, and possibly experts		
Broadly Relevant - has outside stakeholders		

Why are CUREs important?

- Learn the skills of a scientist
- Understand what research is
  - EVERYONE gets undergraduate research experience
- See where chemistry is applied to real world problems
- Learn how to face failures in research
  - Build problem solving and troubleshooting skills

- Create collaborations with peers, teaching team, and experts in the field
- Build skills that employers want in their employees
  - Stand out from competing possible hires

Our CURE Research Topic:
Biochar
(Engineered Biocarbon Materials)

In Collaboration with the
Natural Resources Research Institute

What is Biochar?

- Biomass that has been heated under low oxygen conditions
- Nearly pure carbon in the form of *amorphous graphite*
- High fixed carbon content
- High internal surface area and adsorption properties
- Significant synergisms with soil microbes

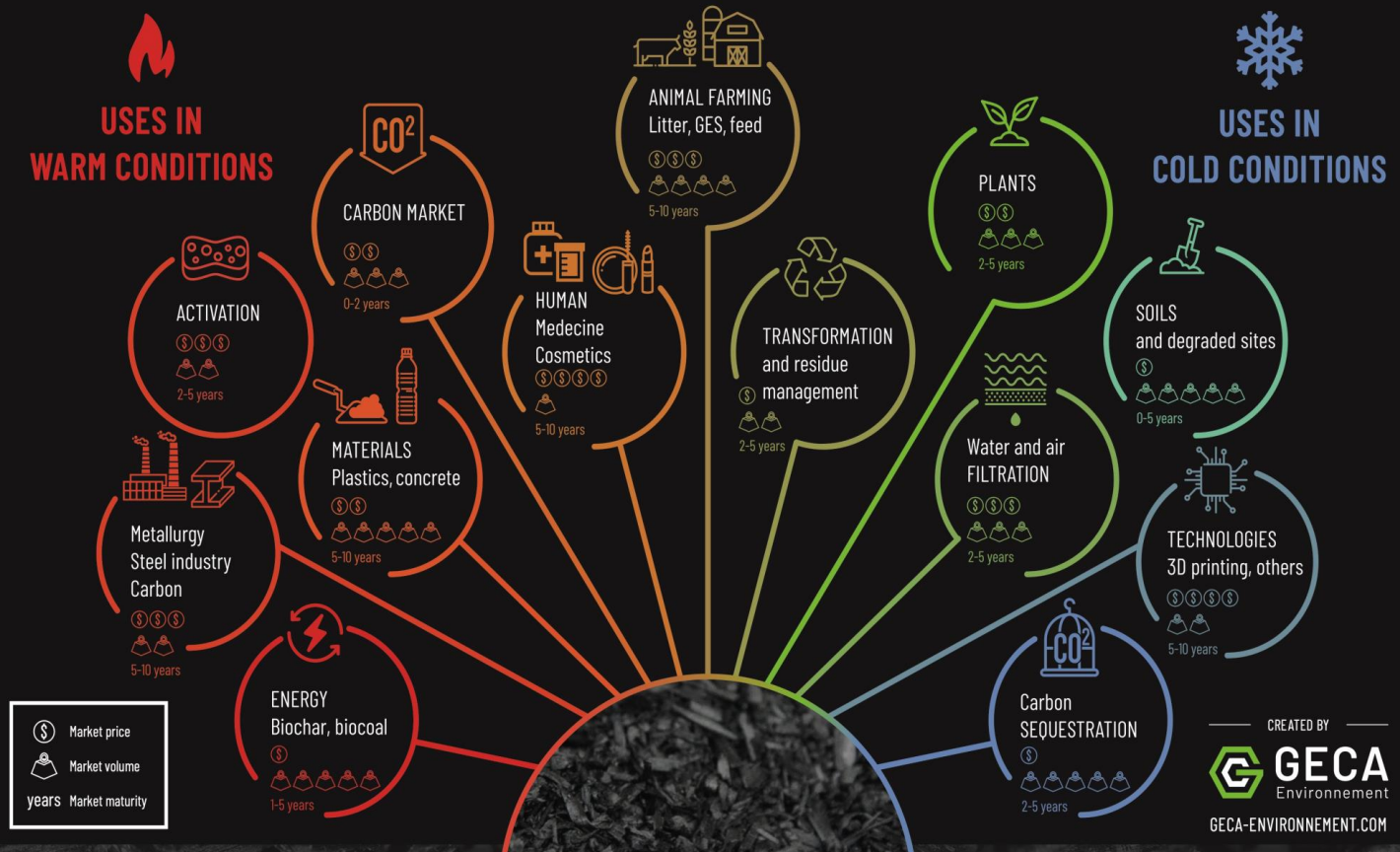
Latosol

Terra preta

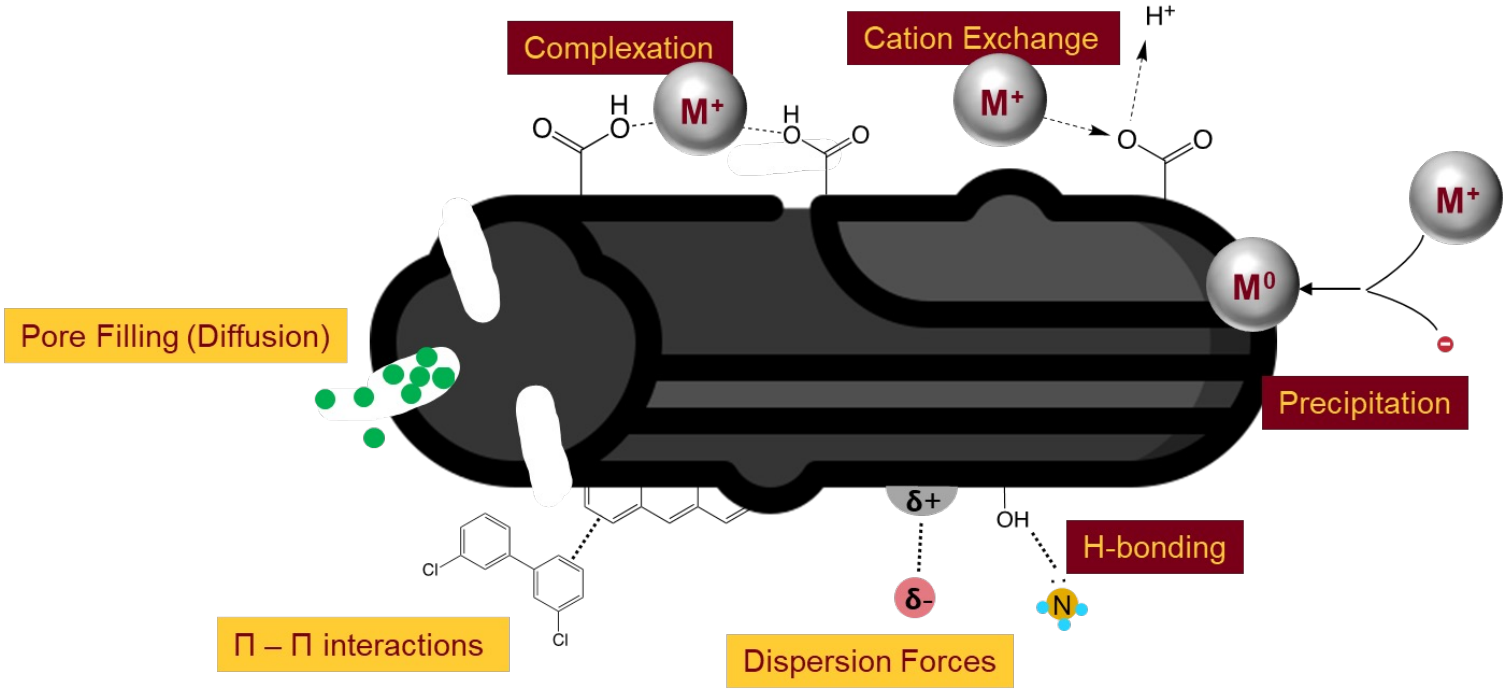
South American Indians probably created *terra preta,* the fertile “dark earths” of the Amazon Basin. Slash-and-char farming between 2,500 and 500 years ago left areas of dark, highly fertile soils in the otherwise infertile red and yellow tropical soils. Soil scientists think that plant charcoal produced by this way of farming lasts for thousands of years and gives these soils their amazing ability to retain nutrients. New insights on this ancient practice may help present-day farmers raise crops sustainably.

Smithsonian Environmental Research Center
https://forces.si.edu/soils/02_08_04.html

BIOCHAR MARKETS



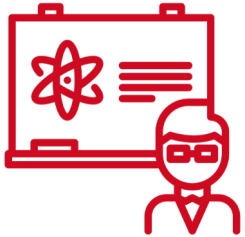
What will Gen Chem Students Measure?



What does the Semester Look Like?

General Lab Schedule

- Before Spring Break: Skill Building
  - Learning General Research Skills
  - Engaging in Lab Exercises design to learn techniques
  - Products:
    - Students write their own research questions
    - Students create an experimental plan / proposal
- After Spring Break
  - Open lab work time for CURE experiments
  - Group meetings and Exit Tickets
  - Products:
    - Poster presentation during finals week



What are my Education Research Questions?

Wainman Group Education Research in CUREs

- ***Research Question 1:***

Do CUREs promote the development of experimental design ability and lab technique as much as traditional labs

- ***Research Question 2:***

Are student perceptions of their abilities well aligned to their actual ability (i.e. is there a Dunning-Kruger effect)? Does a CURE influence these perceptions?

- ***Research Question 3:***

Does completing a CURE in General Chemistry (Year 1) influence outcomes in Quantitative Analysis (Year 2)?

Instruments

- ***Experimental Design Ability***

Experimental Design Ability Test (EDAT)
Score Range (0-10)

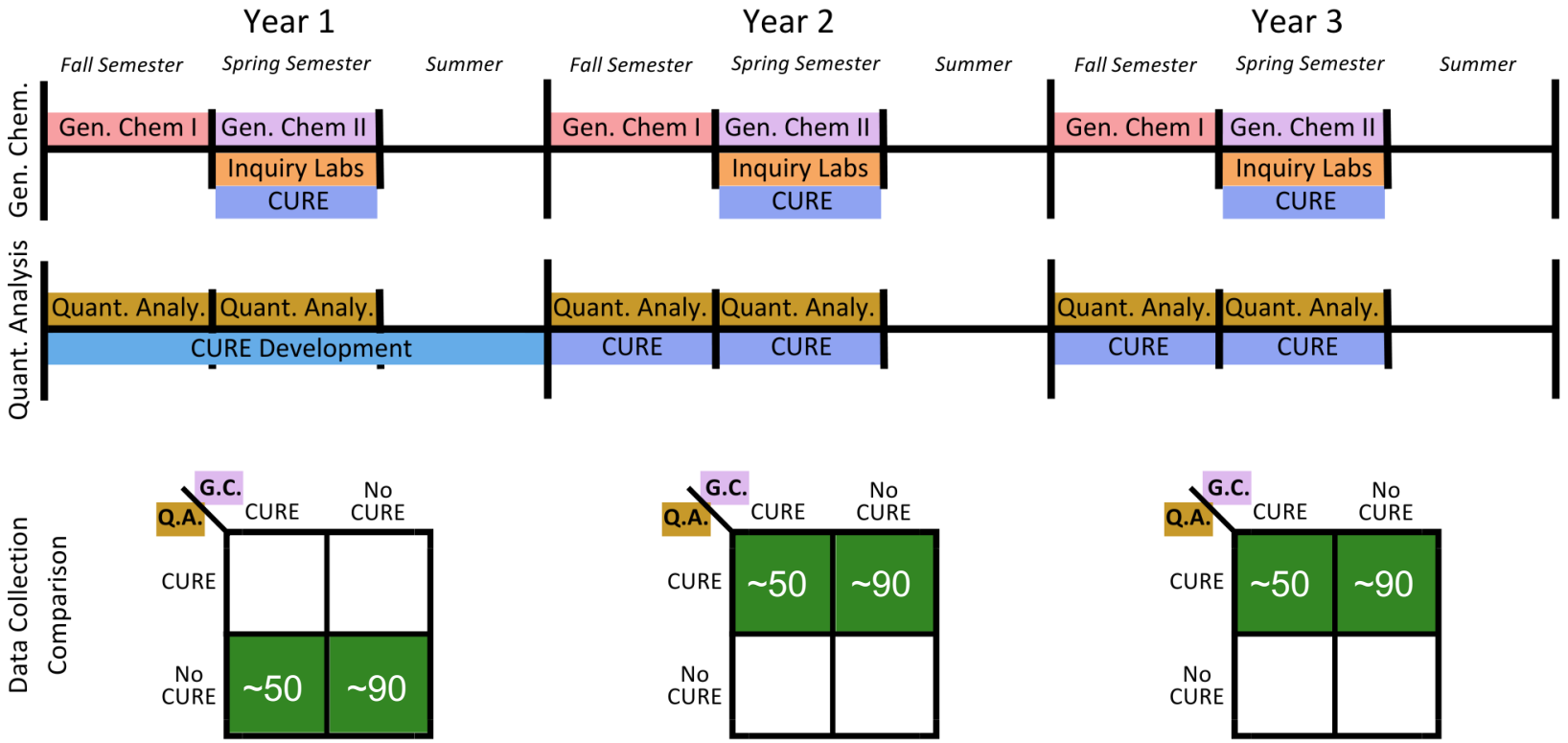
- ***Laboratory Technique***

Digital Badging
Score Range (0-12)
Chemistry Laboratory Observation Checklist (CLOC)
Score Range (0-37)

- ***Self-Perception of Skill***

Self-Reported Percentile
Score Range (0-99)

Participants



Wainman Group Education Research in CUREs

- ***Research Question 1:***

Do CUREs promote the development of experimental design ability and lab technique as much as traditional labs

Compare pre-post scores on EDAT, Digital Badging, and CLOC.

Wainman Group Education Research in CUREs

- ***Research Question 2:***

Are student perceptions of their abilities well aligned to their actual ability (i.e. is there a Dunning-Kruger effect)? Does a CURE influence these perceptions?

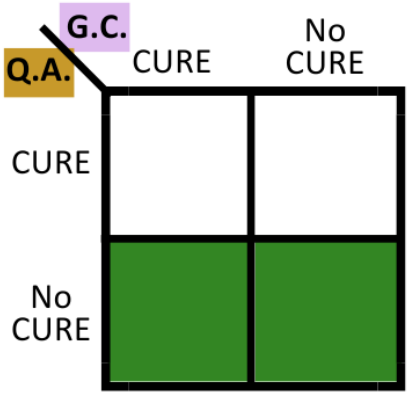
Compare actual ability (measured by instruments) and perceived ability.

Wainman Group Education Research in CUREs

- ***Research Question 3:***

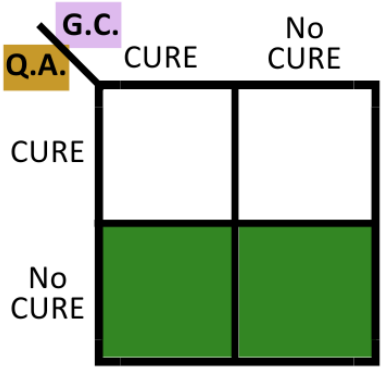
Does completing a CURE in General Chemistry (Year 1) influence outcomes in Quantitative Analysis (Year 2)?

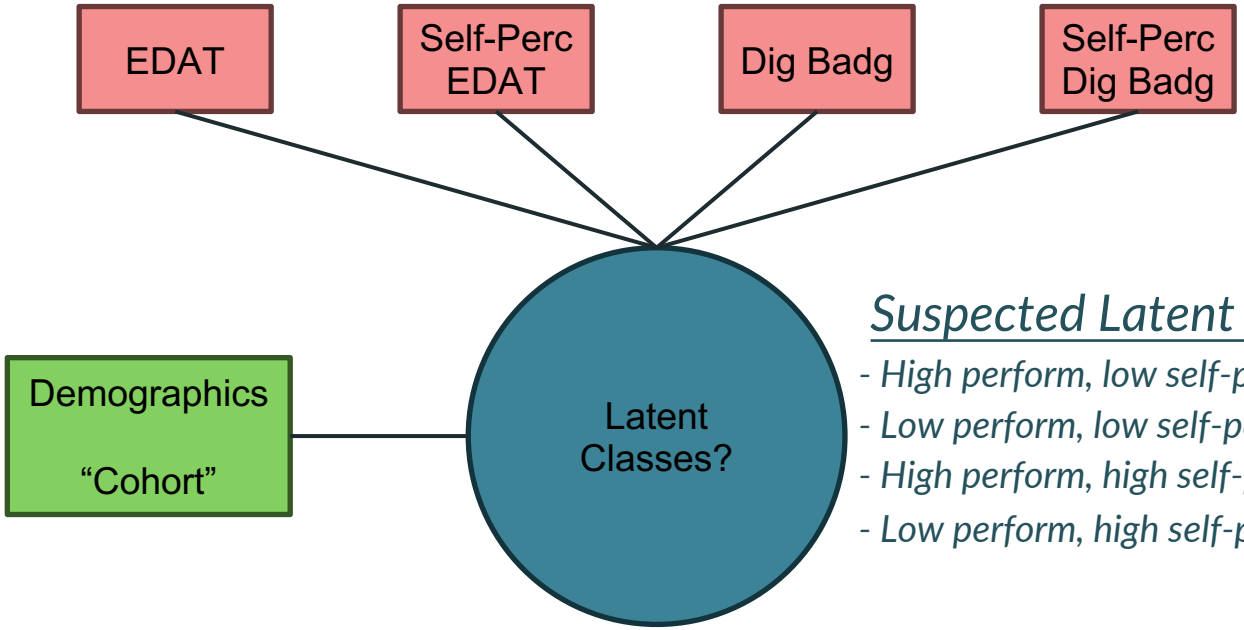
Compare performance among the "cohorts".



What if the cohorts are not homogenous?

Mixture Modeling Preliminary Idea





Suspected Latent Classes:

- *High perform, low self-perception*
- *Low perform, low self-perception*
- *High perform, high self-perception*
- *Low perform, high self-perceptions.*