Creative, Contextual and Engaged: Are *Women* the Engineers of 2020?

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Some Findings from the Academic Pathways Study (APS)

	Longitudinal survey	2nd year structured interviews	Longitudinal unstructured interviews	1st year engineering performance task
Level of (dis)engagement in liberal arts courses	√			
Nature of participation in extracurricular activities	√	√	√	
Social motivation to pursue engineering	√	√	√	
Ways of knowing engineering		√	√	
Ways of doing engineering				√

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Women and men define & delimit engineering differently

- Students were asked: "In your own words, would you please define engineering?"

Highest Response Areas	% of all Responses	Men	%	Women	%
Problem Solving	48.4	29	44.0	15	60.0
Math and Science Application	37.4	28	42.4	6	24.0
Designing/Creating/ Building	37.4	22	33.3	12	48.0
Improving Humankind	28.6	21	31.8	5	20.0

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Discussion of data

- Both men and women saw *problem solving* as a major component of engineering
- Men more often included *improving humankind* in their definitions of engineering
- Women more often defined engineering beyond its traditional technical foundations in math, science, and efficiency

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Discussion of data (continued)

- Women and men conceptualize engineering differently
  - Men's answers tended to be more linear direct, and technically based

One male respondent defined engineering as "coming up with a solution to a problem in an economical way.

  - Women tended to define engineering more broadly

A female respondent defined engineering as being "like the middle man between the inventor and the manufacturer, so [it's] the person that gets an idea and makes it possible."

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“I’d have to say there isn’t an average engineering [student]; they’re very ah-, they’re all unique, let’s put it that way….I was really surprised when I came up here at the female population because I think that is really diverse, just as far as interests and what people are like. Just, I don’t know; the guys kinda come out cookie-cutter….[The guys] want to do math, sit and play on their computers, and video games afterwards; but the girls have more, very diverse interests…

- Michelle, MT

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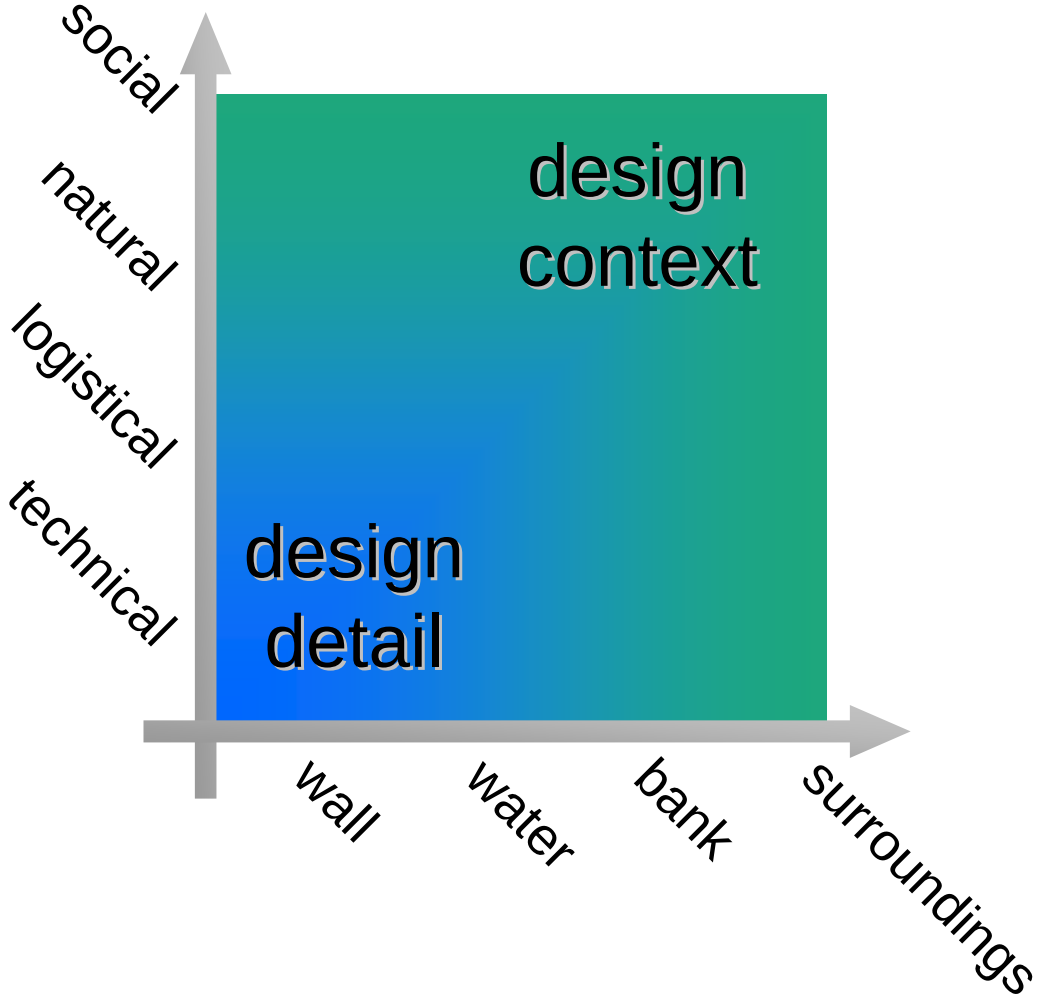
Women and men frame engineering problems differently

Over the summer the Midwest experienced massive flooding of the Mississippi River. What factors would you take into account in designing a retaining wall system for the Mississippi?



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Examples of Detail and Context

Design detail

- "cost of materials"
- "check the budget available for the operation"
- "how to contain the river water that has flooded out"

Design context

- "aesthetic appeal – is it going to draw local complaint?"
- "the surrounding habitat – make sure little or no damage is done to the environment"
- "would wall impact use of the river by industry?"

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Detail vs. Context focus of ideas, overall and by gender

	N	Avg. # segments	% Detail	% Context
Overall	124	11.5	50.0%	50.0%
Women	43	13.0	44.6%	55.4%
Men	81	10.7	52.9%	47.1%

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Women and men are differentially engaged in engineering education: Survey Data

- Longitudinal survey to study development of engineering skills and identity
- Administered to ≈160 students at four institutions, from first to senior year
- Full details in Abstract AC 2007-2392

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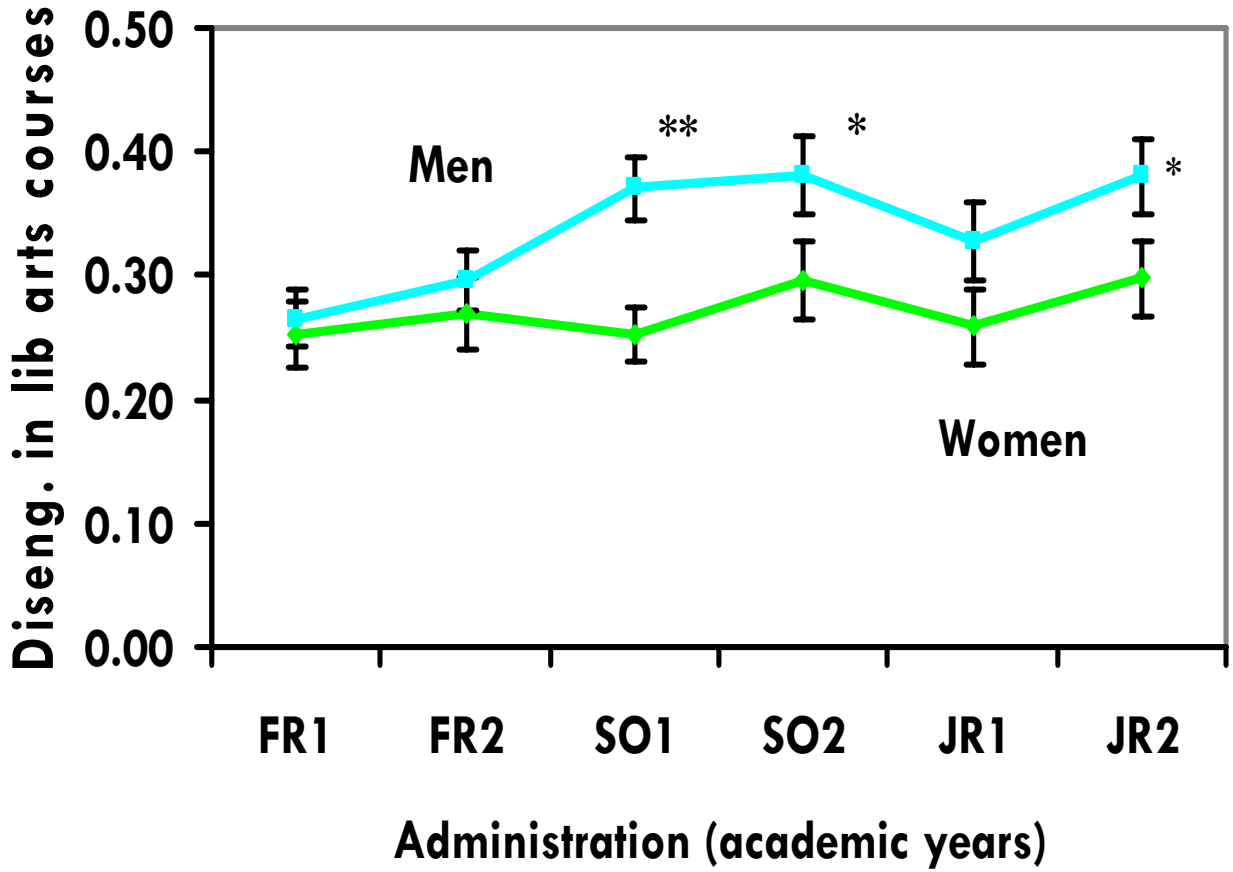
Women and men are differentially engaged in engineering education



Real People, Real Stories of Engagement

- Ethnography adds richness & depth to other methods
- Case studies of 2 participants
- Extremes of different female & male engagement demonstrate poles of experience at MT
- Starkest example of male disengagement; reasonably typical example of female engagement

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Hilary & Max: Common Threads

- Family & social connections to engineering
- Strong interest in math & science
- Majors with application in oil and gas industry
- Recognition of need to work hard at MT
- Internships (targeted across field)

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Divergent Experiences

Hilary

- Student Athlete (Varsity & IM)
- Interdisciplinary minor
- Campus leadership activities
- Professional society through field
- Friends across campus
- Sanguine about hard work
- Satisfied with undergraduate experience

Max

- Opted not to pursue sports
- No minor
- No leadership activities
- Professional society through field
- Friends in major/from HS
- Resentful of hard work
- Deeply dissatisfied with undergraduate experience

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Discussion

- Women defined engineering more broadly
- Women's approach to an engineering problem was more contextual
- Women were more engaged in their overall education
  - Preliminary survey evidence of less disengagement in liberal arts courses
  - Ethnographic evidence of greater engagement

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