Inclusive Caltech Core (IC^2)

May 31, 2019 Wrap-up

- Brief project recap
- Making sense of data
- What next?

(and final input for the funder, AAU!)

Caltech

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Undergraduate Dean's Office

Inclusive Caltech Core (IC^2)

Project Leadership and Implementation Team

Sarah Reisman, Executive Officer of Chemistry and Chemical Engineering; Professor of Chemistry
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*Special thanks to **Dani Yomtov**, CTLO Assessment and Evaluation Specialist, for insightful data analysis on this project!*

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Project recap

Inclusive Caltech Core (IC^2)

- STEM Core & pseudo-core instructors, TAs, and freshman advisors
- Up-to-date student data
- Inclusive & evidence-based teaching

Emphasis on STEM rather than all Core is aligned with funding from AAU and particular challenges of large intro courses. HSS faculty have also participated and have been welcome!

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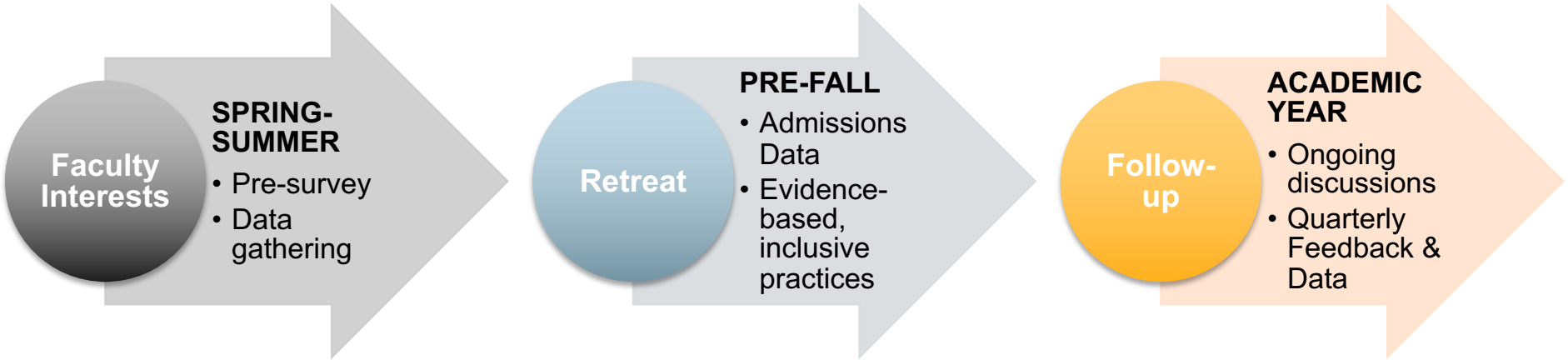
IC² Annual Activities



2017-18 events and discussions

- September 13, 2017
  - **Caltech discussion**: Who are Caltech students and how do they learn?
  - **Guest talk/workshop**: Noah Finkelstein, Practices, Tools, and Evidence for Improving Large Introductory Science and Math Courses
- December 5, 2017
  - **Caltech discussion:** mid-quarter feedback/freshman cohort student experience
  - **Guest talk/workshop**: Gina Frey, Incorporating and Facilitating In-class Group Work
- April 4, 2018
  - **Caltech discussion:** Connections across Core and options – student panel/project; updates on recent student feedback

2018-19 events and discussions

- September 12, 2018
  - **Caltech discussion**: Caltech Student Data and Insights on Teaching
- November 9, 2018
  - **Caltech discussion**: Examples of new methods/practices from Caltech faculty and TAs
- January 14, 2019
  - **Guest talk/workshop**: Michele DiPietro, How Learning Works: Creating Inclusive Environments in STEM (and Everywhere)
- May 31, 2019
  - **Caltech discussion**: IC^2 Wrap-up

Inclusive Caltech Core (IC²)

Syllabus template

Course Code: Course Title
Course Syllabus – Quarter / Year
Department, California Institute of Technology

Course Instructor
Name + Pronouns
Contact Information (office, phone number, email address)
Office Hours

Teaching Assistant(s)
Name + Pronouns
Contact Information (office, phone number, email address)
Office Hours

Course Description
Insert course description here as seen in the Caltech Catalog. You may also want to explicitly state the prerequisites.

Course Welcome
You may choose to use this space to welcome students to your course, set a positive tone for the class, allude to why the course is important and interesting beyond the formal course description, introduce your method of lecturing and use of active learning, and communicate any expectations that you might have.

Learning Outcomes
By the end of this course, students will be able to:

- Learning outcome 1
- Learning outcome 2
- Learning outcome 3
- Learning outcome 4
- Learning outcome 5

Required Text
Required textbooks and where they can be purchased / found / whether they are on reserve at the Caltech library.

Course Website or Learning Management System
List the online course resources (websites or learning management systems) that your course will use. Give information about how students can access these resources (e.g. if a password is needed).

Assessment Rubric
*Give a percentage breakdown of how you will be assessing your students here (e.g. problems sets 5 * 5%, final exam 30%, etc.). As much detail as possible will be appreciated by your students!*

Large Core course map & links for each quarter

2018-19 Program Details | **Winter 2019 Classes + Info** | Fall 2018 Classes + Info | 2017-18 Program Details

WINTER 2019 CLASSES + INFO

2018-19 Caltech Academic Calendar

Winter 2019 Caltech Core Science/Math:

Course + Website	Lectures	Recitations	Chandler Group Study	Problem Sets & Quizzes
Ma 1b practical Ma 1b analytical	MWF	R (Thurs)	F 8-11 pm	Pr: M 2pm (sets) An: M 4 pm (sets)
Ph 1b practical Pb 1b analytical	Pr: F An: WF	Pr: MWR An: MR	M 8-11 pm	Pr: F 4 pm (sets) An: W 4 pm (sets); 4 quizzes
Ch 1b Moodle; (pdf syllabus)	MTR	W	T 8-11 pm	F 4 pm

*Group study sessions in Chandler, organized by the Undergraduate Dean's Office, give studnets an opportunity to find others and collaborate/discuss course material, with tutors in attendance to answer questions and assist.

Approximate Weekly Topics:

Note: timing may change or vary as the term progresses - check course website or ask faculty/TAs.

Winter 2019	Ma 1b practical	Ph 1b practical	Ph 1b analytical	Ch1b
Wk 1 1/7-13	Systems of linear equations, Gaussian elimination, homogeneous equations; Vectors, geometric interpretation; Matrices, matrix operations, square matrices.	Electric Fields	Principles of Relativity and Time Dilation; Length Contraction & Simultaneity	Potential Energy Surfaces; Nuclear quantum states; Diatomic vibrations; Polyatomic Vibrational Spectra
Wk 2 1/14-20	Inverses of matrices, determinants, cofactor expansions, product rule.	Gauss's Law, Electric Potential	Invariant Interval, Lorentz Transformation; Causality, Relativistic Mechanics	Rotational spectroscopy; Microscopic vs. Macroscopic Ensemble averages; Boltzmann distribution; Ideal gas law; Non-ideal equations of state
Wk 3 1/21-27	Computing inverses of matrices, Cramer's Rule; Vector spaces, subspaces, null space of a matrix.	Current and Resistance	Relativistic Collisions & Decays; Mass/Energy Conversion, Nuclear	Thermo: 1st Law;Reversible & Irreversible processes

THE INCLUSIVE CALTECH CORE (IC^2) PROJECT

Engaging Faculty

Using Data

Addressing Equity

>50 faculty per year participated in IC^2, along with staff, students, and TAs.

Term	Fall 2017 entering class	Fall 2018 entering class
Fall	• Mid-quarter feedback: Ma 1a, Ph 1a, Ch 1a • Overall questions • 85% response rate	• Mid-quarter feedback: Ma 1a, Ph 1a, Ch 1a • Overall questions • 90% response rate
Winter	• Mid-quarter feedback: Ma 1b, Ph 1b, Ch 1b • Overall questions • 68% response rate	• Mid-quarter feedback: Ma 1b, Ph 1b, Ch 1b • Overall questions • 54% response rate
Spring	• Mid-quarter feedback: Ma 1c, Ph 1c, Bi 1 • Overall questions • 46% response rate	• Mid-quarter feedback: Ma 1c, Ph 1c, Bi 1 • Overall questions • 41% response rate
Fall	• Mid-quarter feedback: Ma 2, Ph 2a • Overall questions • 48% response rate	
Winter 2019	• Mid-quarter feedback: Ma 3, Ph 2b • Overall questions • 17% response rate	**Malleable traits / student success** https://www.nap.edu/resource/24697/interactive/

Data themes:

- **Gender/other gaps in confidence** (not related to ability)
- **Evolution of academic self-concept** in the first year
- **Knowledge of vs./and use of resources**

Inclusive teaching practices: *tend to* ***enhance learning*** *for all students and* ***reduce gaps*** *for traditionally underrepresented students*

- **Active learning** using techniques to ensure inclusive participation (e.g., intentional discussion moments; think-pair-share; “clickers”)
- **Transparency** (e.g., goals; syllabi; assignments that explicitly share the purpose, process/tasks, & criteria)
- **Structure** (e.g., expert knowledge structures; outline/goals for class session)
- **Assessments** (e.g., aligned with course goals)

Making sense of data

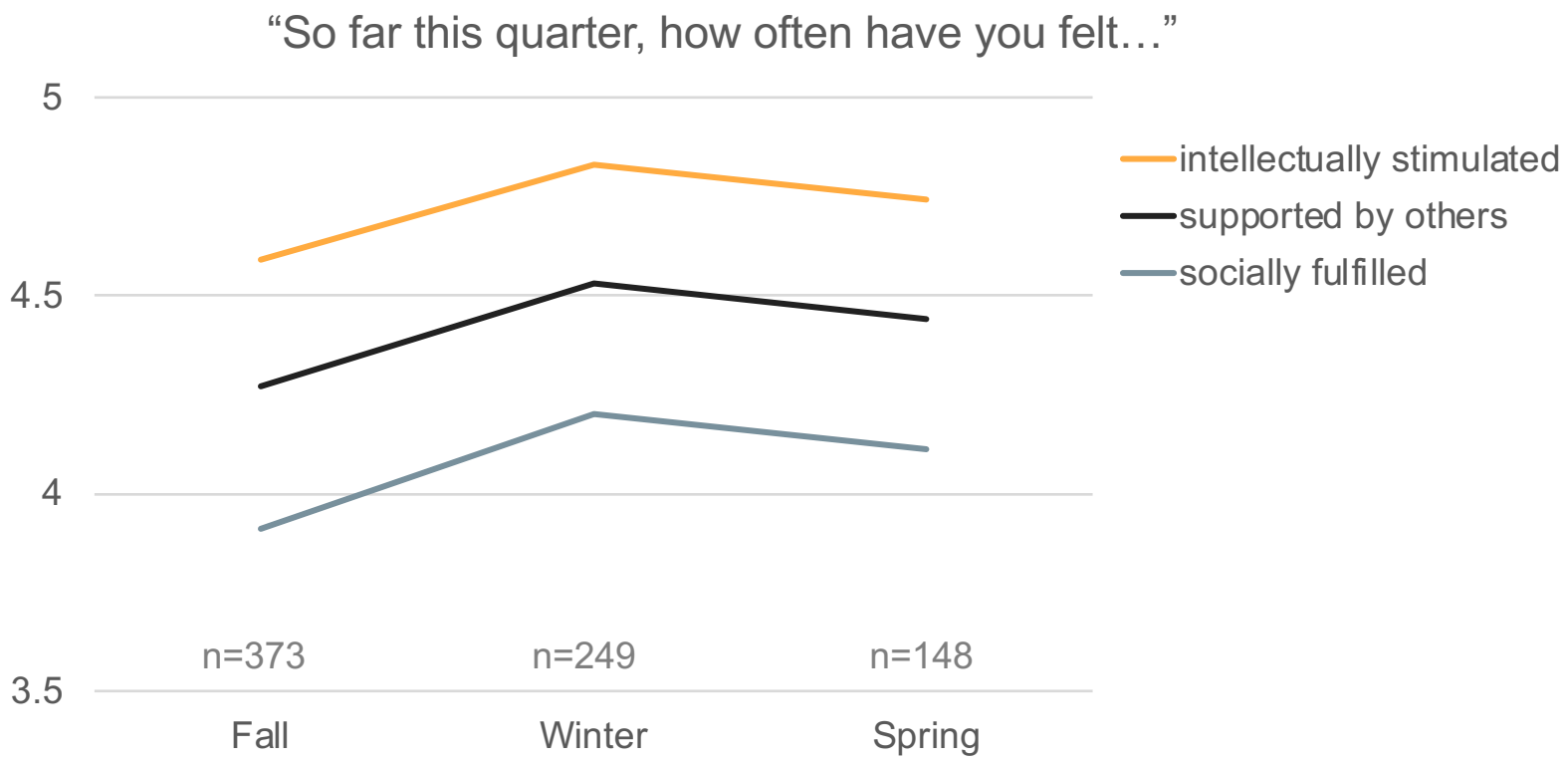
NOTE: Everything we'll show and discuss today is at the $p<0.05$ level or better.
Used a growth curve analysis approach on the combined cohorts time series in order to examine both time and gender effects.
We're showing results where changes in time and/or gender differences were significant.

What’s going well?

Combined freshman year (2 cohorts: entering fall of 2017 & 2018)

SCALE:
5 very often

4 often



(3 sometimes, 2, rarely, 1 never)

Strong association between recognizing need for support and seeking support

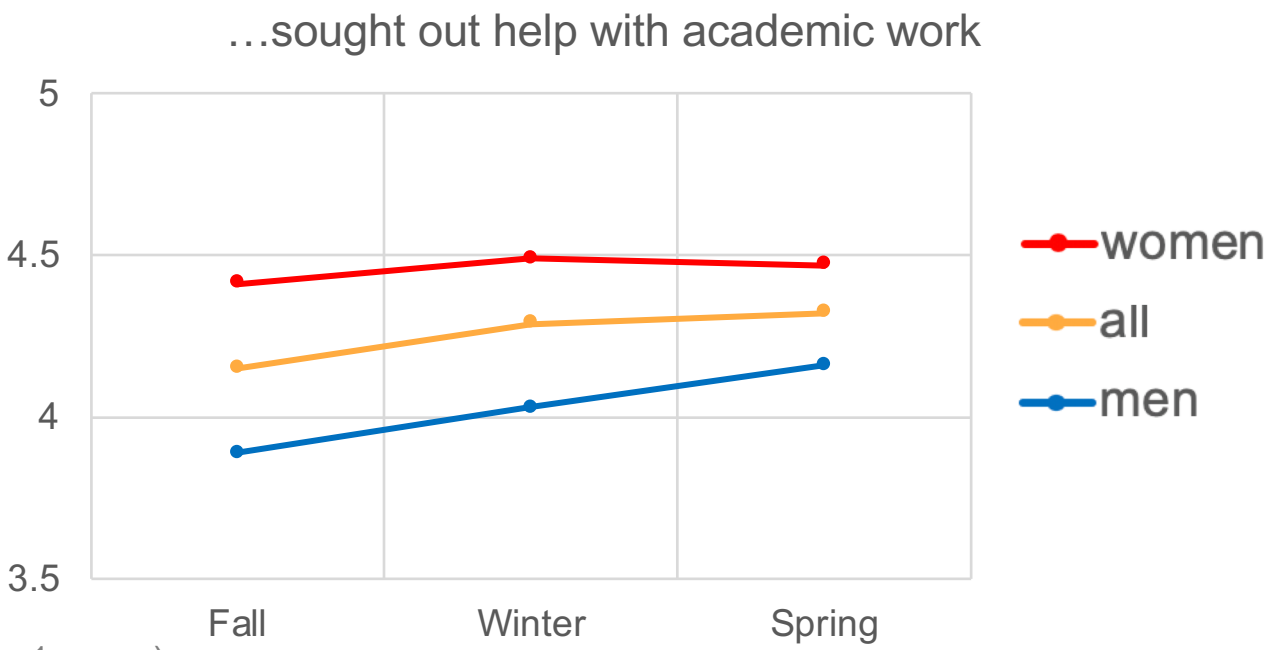
- More students recognize the need for, and seek, academic support than for non-academic support
- Men are less likely to recognize the need for both academic and non-academic support
- Once students recognize the need for support, they’re likely to seek it out

E.g.: “So far this quarter, how often have you…”

SCALE:
5 very often

4 often

(3 sometimes, 2, rarely, 1 never)



More detail is available –

Academic support			
	Recognized the need for support and sought support	Recognized the need for support and did not seek support	Neither recognized the need for or sought support
Fall	293 (78.8%)	18 (4.8%)	61 (16.4%)
Winter	210 (84.0%)	6 (2.4%)	34 (13.6%)
Spring	125 (84.5%)	5 (3.4%)	18 (12.2%)

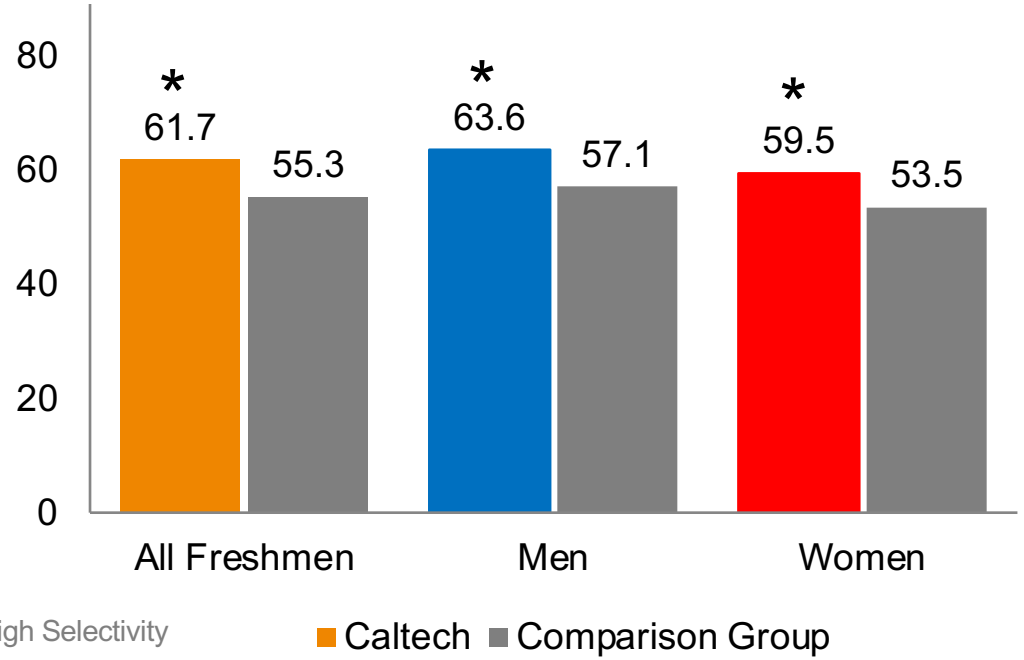
Non-Academic support			
	Recognized the need for support and sought support	Recognized the need for support and did not seek support	Neither recognized the need for or sought support
Fall	128 (34.7%)	80 (21.7%)	161 (43.6%)
Winter	100 (40.3%)	48 (19.4%)	100 (40.3%)
Spring	45 (30.6%)	19 (12.9%)	83 (56.5%)

Incoming Caltech students are academically confident with a strong "Academic Self-Concept"

Discussed at the September 2017 IC² retreat

Academic Self-Concept includes these self-rated components:

- Academic ability
- Mathematical ability
- Intellectual self-confidence
- Drive to achieve



Source: 2016 CIRP Freshman Survey (TFS)
Completed by incoming freshmen (i.e. self-reported data)
Caltech + Comparison Group of Private Universities with Very High Selectivity

Fall 2017 Caltech Core Faculty and Freshman Advisors:

‘We expect academic self-concept to decrease when students arrive at Caltech. The hope is that it recovers and is built on a solid foundation. Does that happen?’

Academic Self-Concept includes these self-rated components:

- Academic ability
- Mathematical ability
- Intellectual self-confidence
- Drive to achieve

Following Academic Self-concept and related behaviors:

Significant rise from mid-quarter fall to spring; varying gender effects

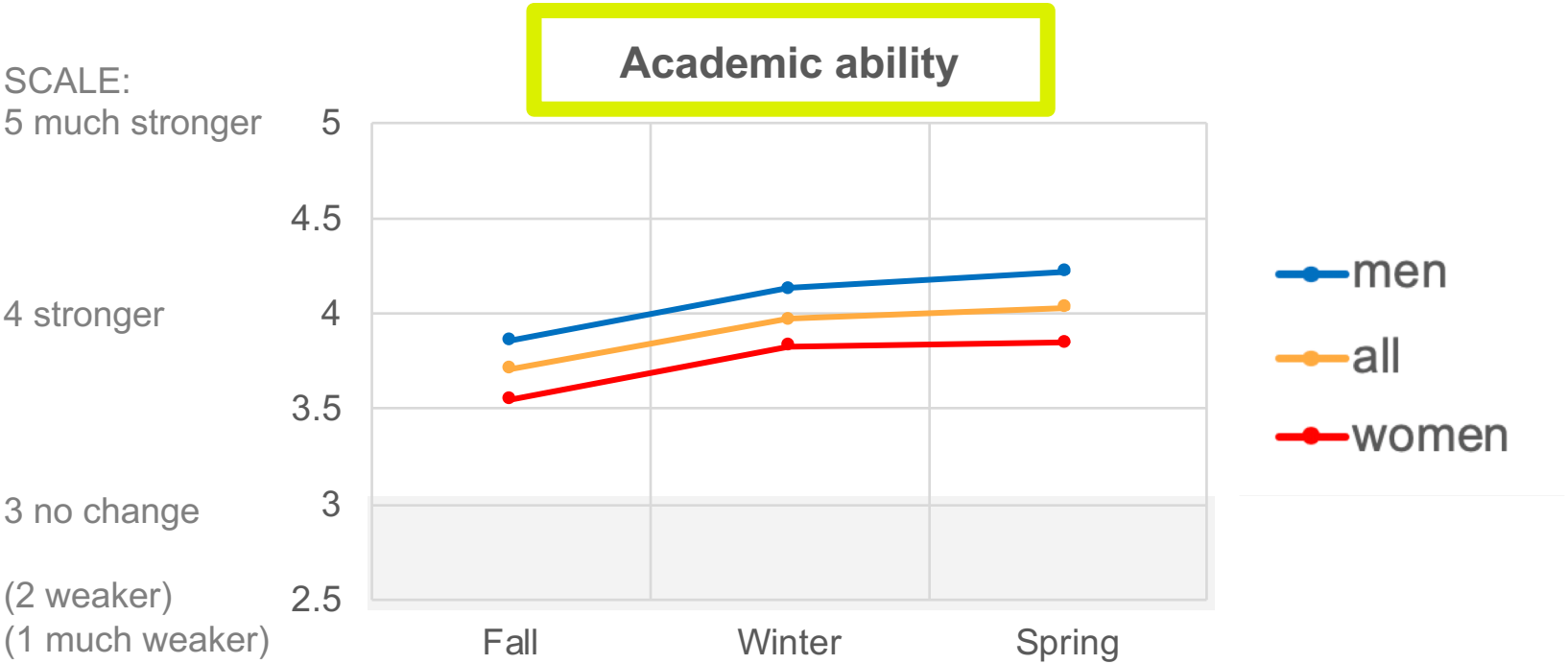
Academic Ability

Mathematical Ability

Following Academic Self-concept and related behaviors:

"Since starting at Caltech, how do you feel you've changed in the following areas?"

Significant rise from mid-quarter fall to spring; gender differences persist



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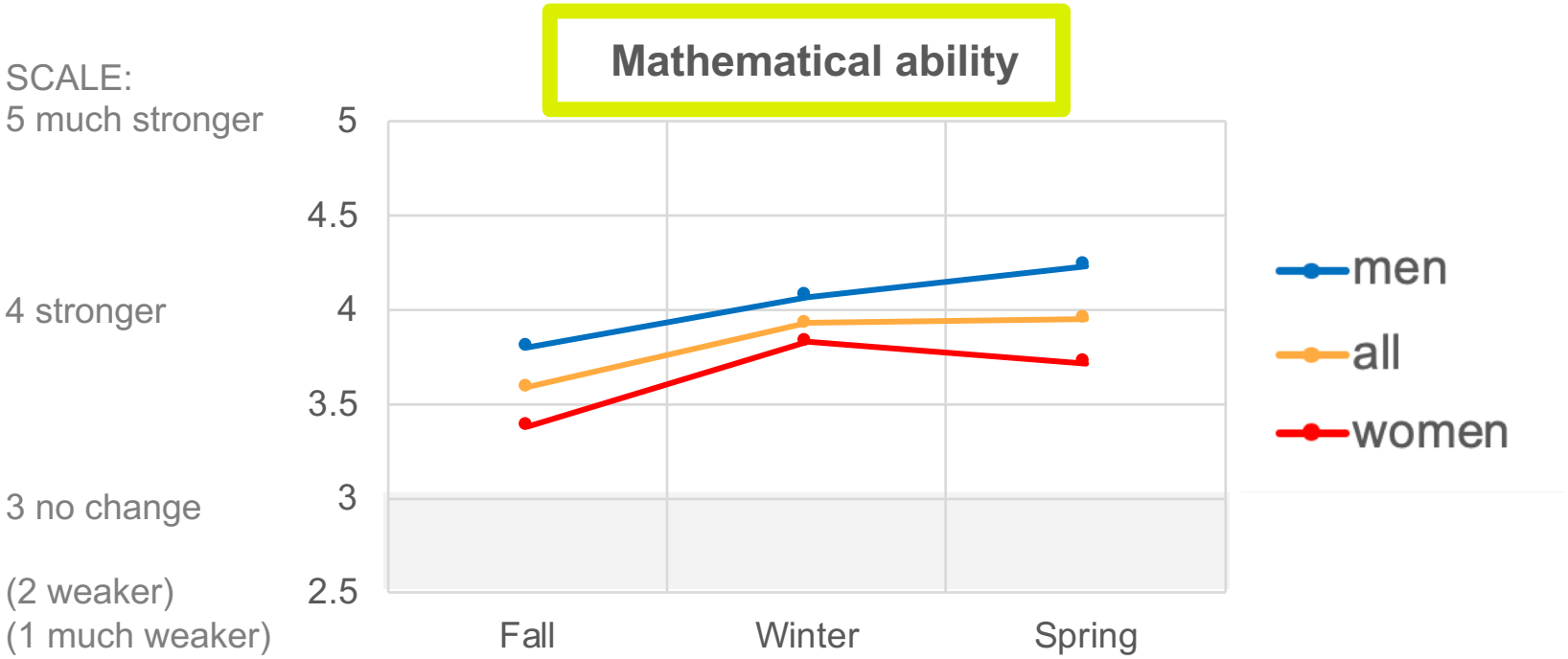
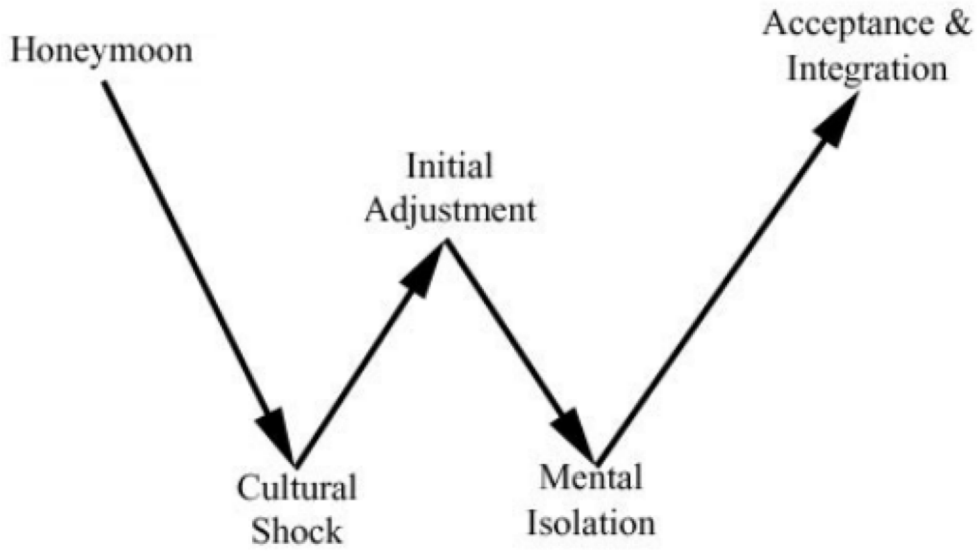


The First Year: The W-Curve

- Describes first-year college students adapting to a new culture
- Ups and downs are a normal part of this transition



Following Academic Self-concept and related behaviors:

Significant rise from mid-quarter fall to spring with ups and downs:

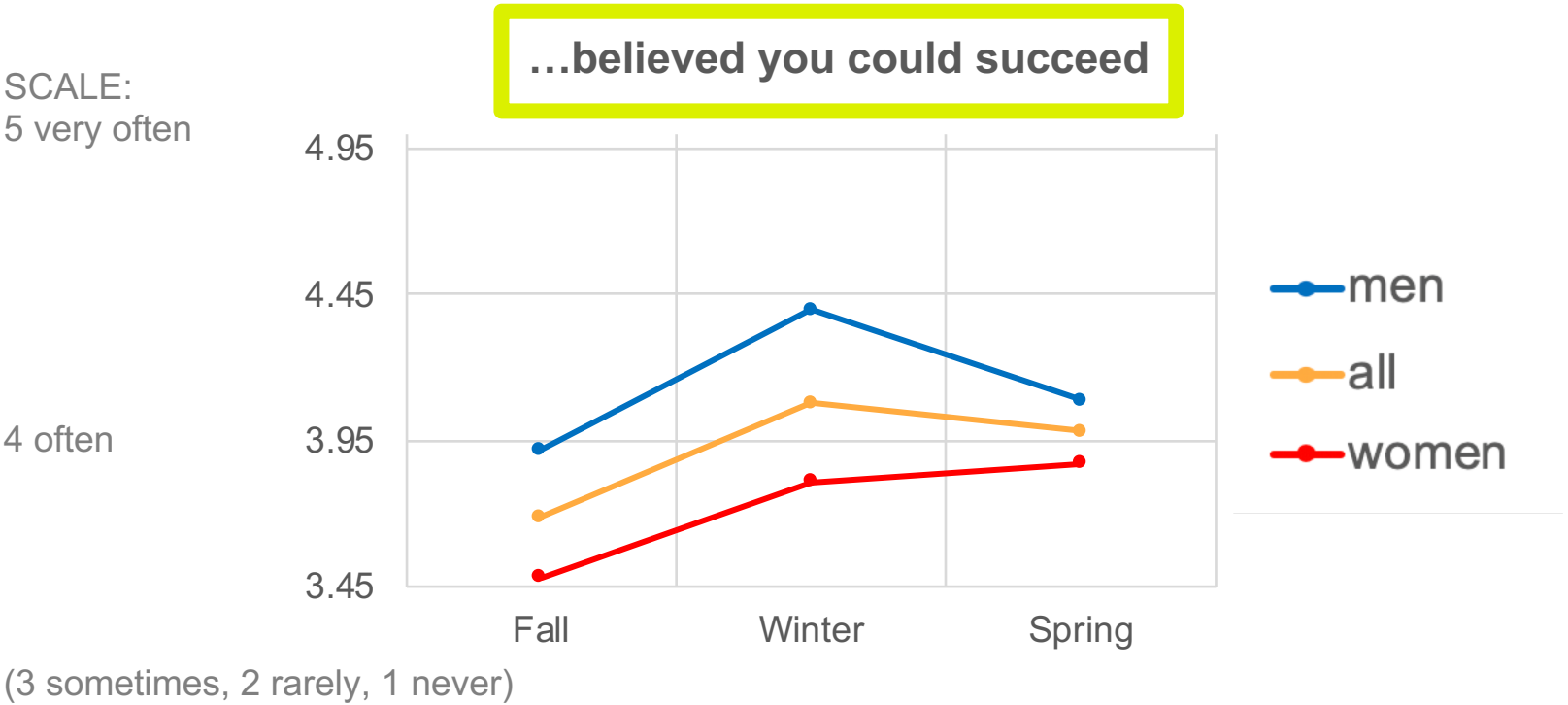
Sense of belonging

Belief in ability to succeed

Following Academic Self-concept and related behaviors:

"So far this quarter, how often have you…"

Significant rise from mid-quarter fall to spring with ups and downs:



(3 sometimes, 2 rarely, 1 never)

Following Academic Self-concept and related behaviors:

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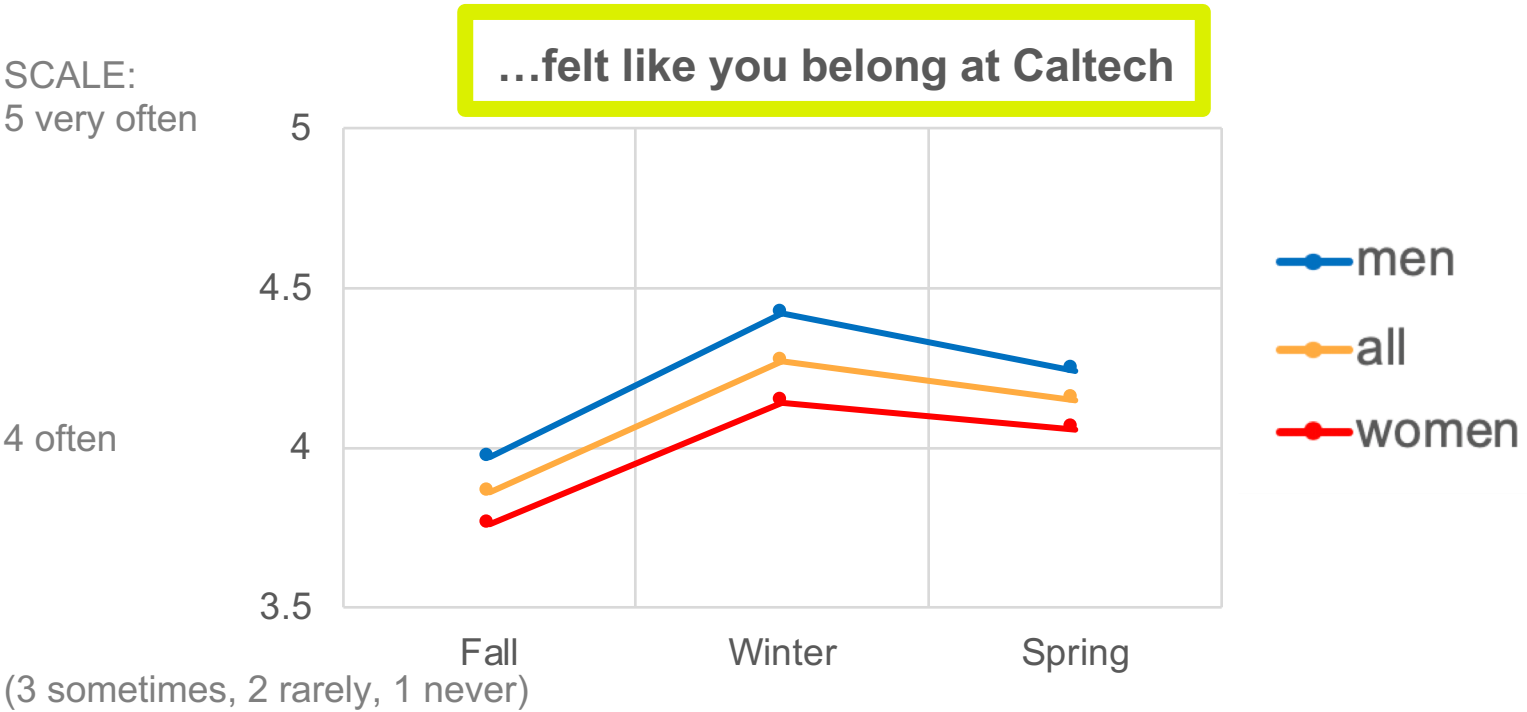
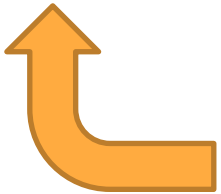


In groups of three:

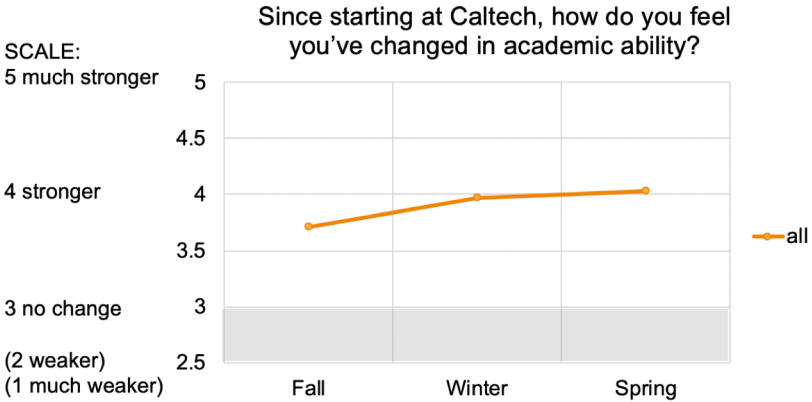
Examine the trajectories on your handout and discuss:

- Do these reflect your experiences/observations?
- Are they “ideal”? If not, in what ways?
- What could we do differently?



we = individuals, groups, programs/options, faculty, staff, students, etc.

Average first-year trajectories:



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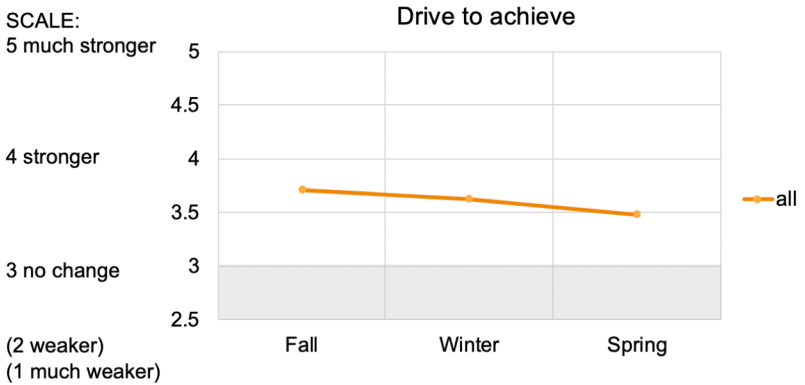
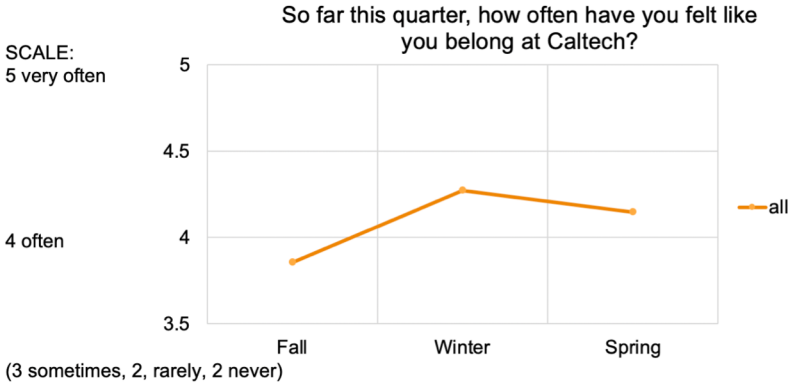




Discussion

- Students found that the sense of belonging data tracks their experience; the “W curve” phenomenon. Very early upon arrival, everything is great. By mid-quarter fall – dips. Winter – rebound.
- How bimodal is it? Look at distributions next. Do some REALLY feel like they belong? Others not at all? (NOTE: see prior discussion slides, 2017-18 and 2018-19, where we looked at histograms on individual items
- Spring dip – small dip in average… drive to achieve – may or may not be a real change (even if statistically significant).
- Faculty/deans may tend to see students who are struggling more. Averages are higher than the subset according to their expectations.
- Self-perception vs. actual? A next step is to look at other variables like grades.

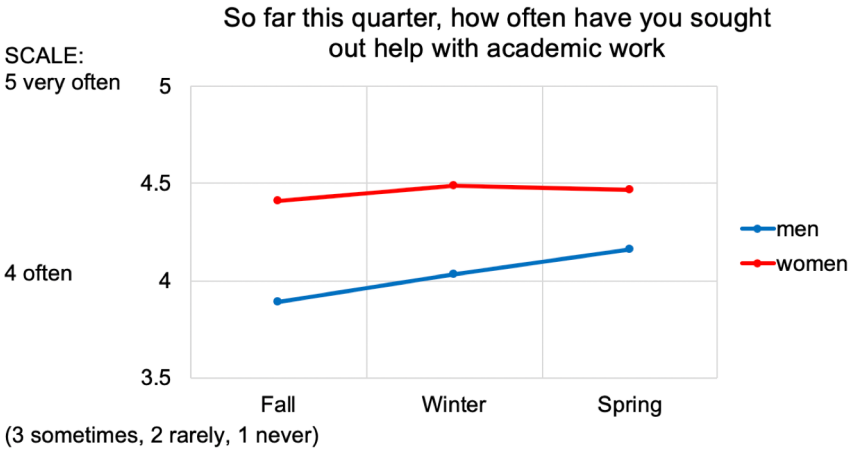
Discussion

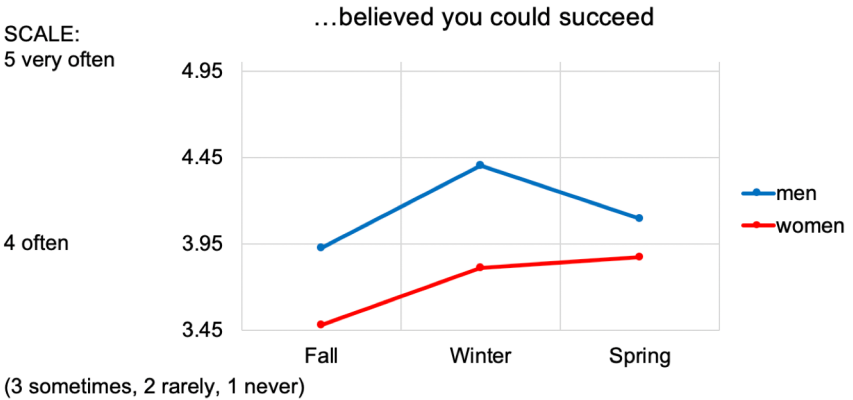
- What could we do differently?
  - Students: something that's helpful for developing a sense of belonging is having smaller group interactions and one-to-one time with faculty. Helps you feel like some adult here cares, wants you to succeed. A lot of opportunities offered, but there may be students who don't recognize how useful or don't take advantage of it. People who have fallen through the cracks – how to engage them early?
    - How could we do that? Frosh advisors – lunch every term as a group was good (not everyone does that as an advisor). Make it more of a standard thing that just happens.
    - A lot of variation in advisors – some see often, some see only once and never again.
    - More freshman advisors? So there's not as big a group per advisor?
  - From advising standpoint – if a student doesn't show up to an advising lunch, it's a sign they might be struggling.
  - The idea of freshman seminars was to foster this kind of interaction… but enrollment is low and faculty interest waned. Pressure to take other classes, CS, etc. Reexamine these questions.
- Meeting in the middle – top down, structures, etc. and student peer culture and practices – both are important

Discussion

- Students - Many opportunities / students may not take advantage – time, pressure to complete work, email overwhelm. Culture change needed in order to use those opportunities.
- Core physics – a lot of sections, faculty-led. Poorer attended than grad student TA-led recitations. This term, two sections, average 0 to 1 attendees per section. Are there “wattages” of faculty time to deploy to other roles where interaction would be more meaningful?
  - What are the root causes?
  - Poll. Faculty change often. Doesn’t seem to be individual faculty basis, more comfortable with grad students and being confused.
- Ge1 – also Undergrad TA-led recitations are much better attended.
  - Possible that UTAs have volunteered? Yes

Gender-differentiated trajectories:





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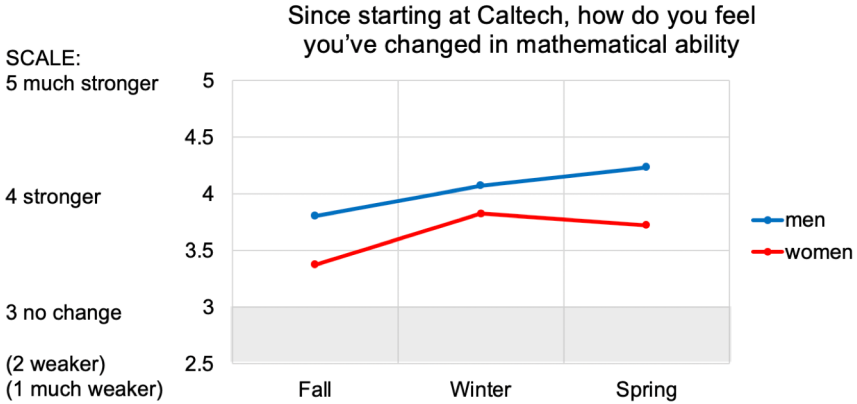


Discussion

- Loosely in terms of trends – consistent. Dip in winter by experience of faculty, not in averages (surprising)
- Lines converging and upward sloping – better than not!
- Hard to interpret – concerning if there's divergence in feeling stronger in mathematical ability (not tracking)… hard to tell with these data (limited)
- If you could get at this at a finer grain – what are their options, what are they enrolled in? Academic performance…
- Hard with limited women faculty – in Core – no women faculty in first year Core. That can be problematic and not ideal. What is the representation at the TA level in terms of gender? Is that a place we can help with identity / role model in those early quarters? Something to follow up with options about in terms of TA assignments?
- Dean – lunch with a group of frosh women – had yet to see a woman faculty member, except in HSS (which in some way was reaffirming stereotypes/expectations of fewer women in STEM).
- Felicia Hunt is working on a first year experience framework; not fair to ask all women faculty to start teaching in Core. Other ways to meaningfully engage…
- All self-perception – actual performance? This agrees with advisor experiences. Women more likely to have confidence questions and seek help.

Discussion

- Winter: men spike in belief you can succeed? This is before mid-quarter warnings (which go up in winter).
- Freshman progress reports in chemistry all give a percentile / median with shadow grade. Physics and math – may not know relative to the class median. A practice that could spread from chemistry?
- Belief you can succeed? Prior to arrival at Caltech? – how much does is the decline? Is the fall decline bigger for women or different?
    - We can't measure it in the same way as the pre-freshman surveys Caltech contracts with external groups to do, but overall academic self-concept is very strong coming in; it is likely that the fall term is lower.
- This project has informed freshman orientation directly…
    - But just information sharing didn't fully dispel stereotype threat. More often? Ina different way?
- 25 years worth of TFS survey – historically – women come in with lower self-perception. Even in years prior. Women tend to have studies more
- Make it more of a standard practice for frosh advisors to be discussing their individual place in grades relative to median at meetings?

Following Academic Self-concept and related behaviors:

"Since starting at Caltech, how do you feel you've changed in the following areas?"

INTELLECTUAL CONFIDENCE – more complex:

not changing and perceived by some students as getting weaker.

Following Academic Self-concept and related behaviors:

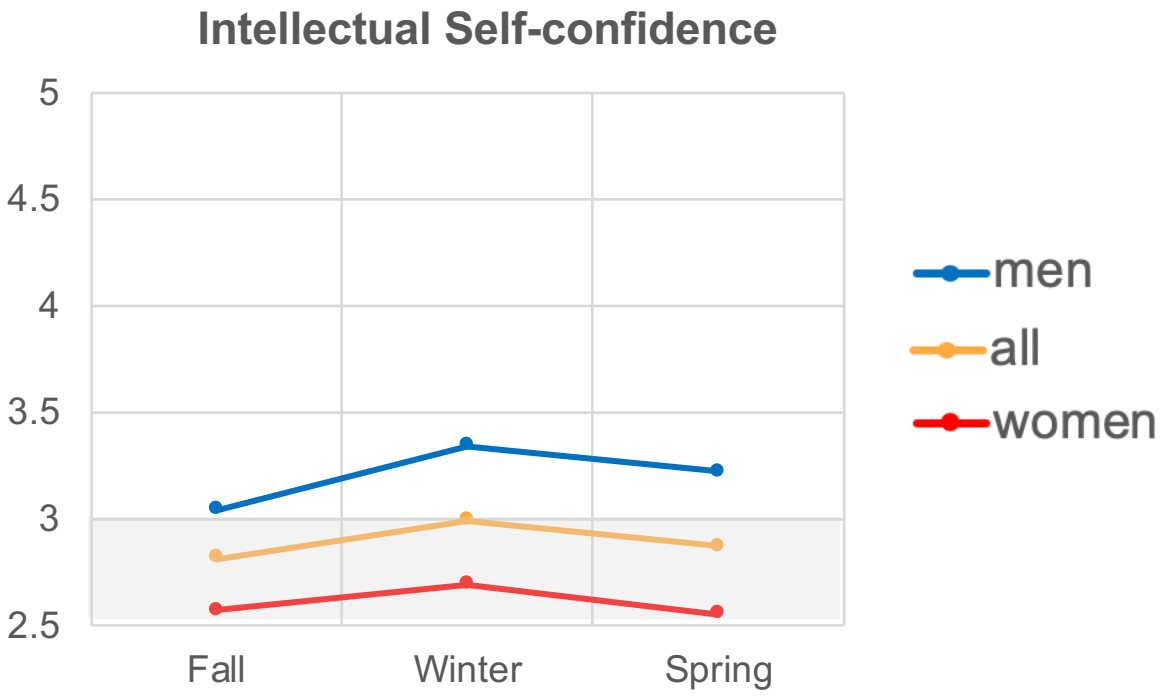
"Since starting at Caltech, how do you feel you've changed in the following areas?"

SCALE:
5 much stronger

4 stronger

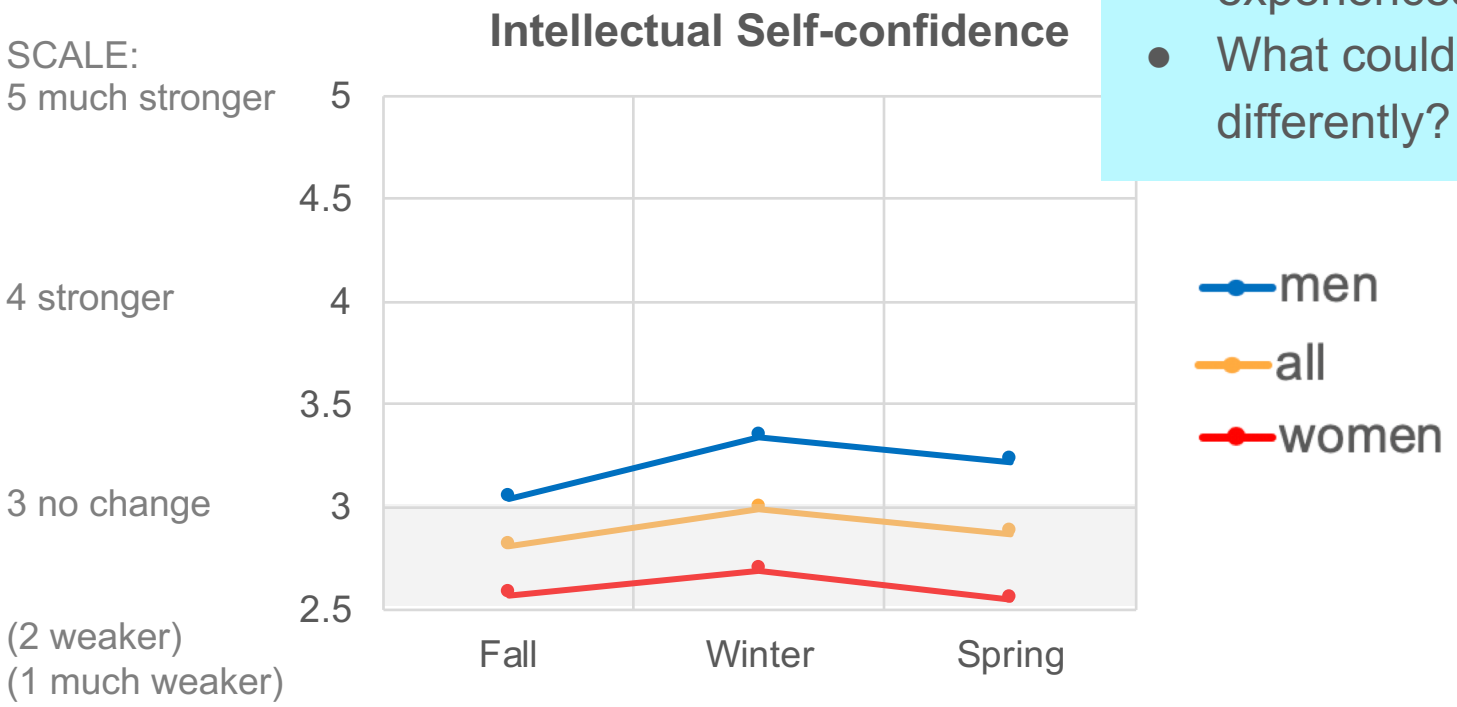
3 no change

(2 weaker)
(1 much weaker)



All together:

- How/why does intellectual confidence matter?
- Does this reflect your experiences/observations?
- What could we do differently?



Discussion

- Difference between academic ability and intellectual self-confidence trajectories. Troubling in that some are developing abilities AND losing confidence. Burn-out?
  - Why the disconnect? Guesses?
  - Not surprising… smartest kid in high school. Not at Caltech. Getting out into workforce – some alumni say ‘I didn’t know how great I was until I left Caltech’
  - Ways to recalibrate more while they’re here? E.g., educational outreach
- More interested in absolute value than the change – derivative. There’s a pathology of overconfidence. Also under confidence (giving up). But who’s hitting the floor and giving up? Not apparent. Ok if staying in a productive difficulty bandwidth.

Discussion

- If start with a lot of confidence – “no change” is ok!
- Is there a calibration that’s productive?
- Extracurriculars in HS might supplement self-confidence… more immediately rewarding.
    - At Caltech, that may get squeezed out. Turn more only toward academics. Some may lose the extra support from other pursuits and interests.
- After soph year – students feel they can do anything! Ask this alter.
- Bottom up and top down – crucial. Advisors say X. Peers say Y (peer pressure to overload/enroll differently, etc.) and squeeze out extracurriculars.

What next?

What next?

Summer 2019:

- Additional analyses with academic data for the two cohorts
- Final reports for Caltech and AAU

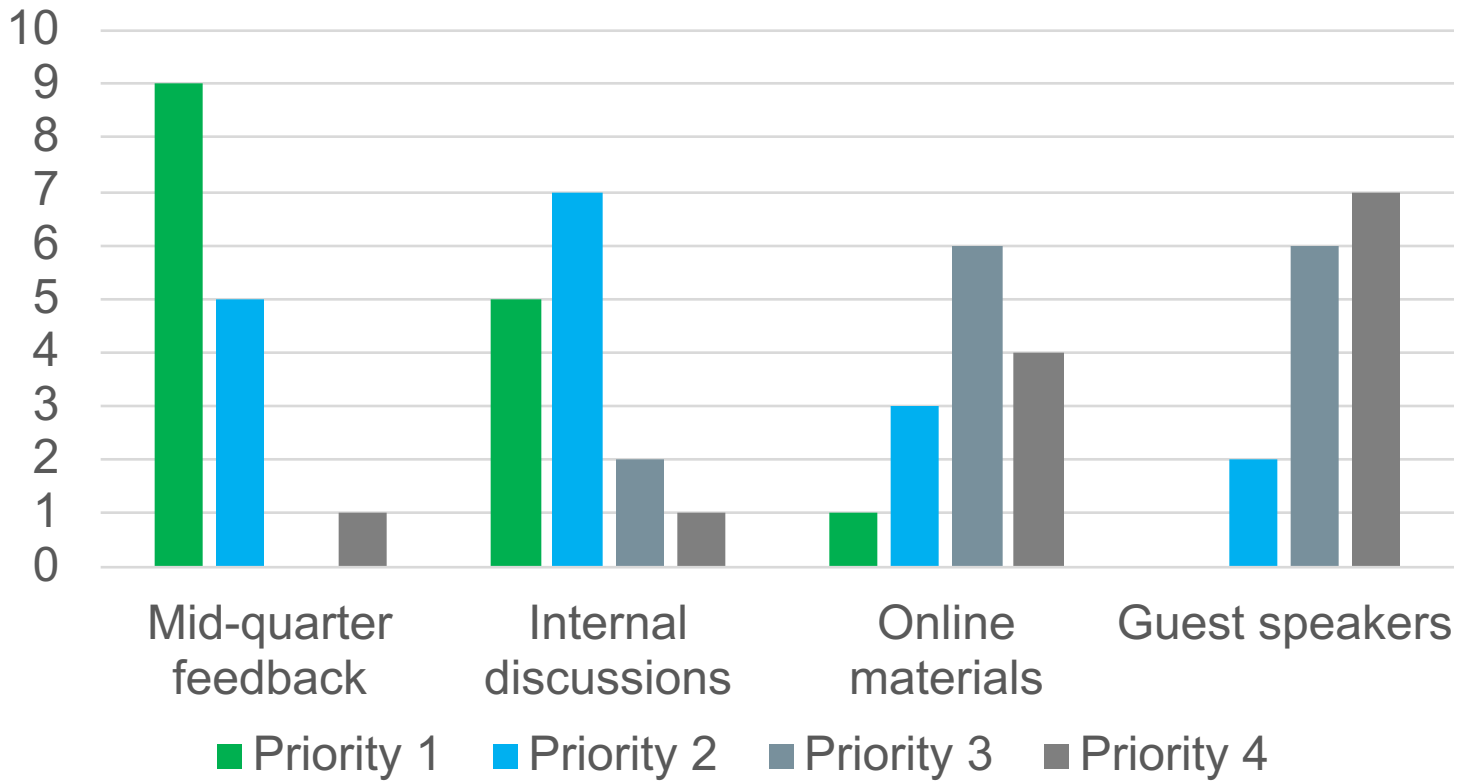
Next year:

? Your input is needed! What's most important to continue or build on?

Please take a few minutes to fill this out individually before you leave today.

Your responses are crucial for the final project report and planning for the next academic year.

	What do you think has changed or improved as a result of this program element?	In what order would you prioritize continuing this program element? (mark 1, 2, 3, 4 or NA; briefly, why?)
Mid-quarter feedback for individual Core courses, faculty, and TAs		
Engaging with external guest speakers/ workshop facilitators on inclusive teaching methods		
Discussing up-to-date data and examples of practices within the Caltech community		
Online materials (e.g., grid of main Core topics by week; syllabus template)		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Mid-quarter feedback
Internal discussions
Online materials
Guest speakers
Priority 1
Priority 2
Priority 3
Priority 4

COMMENTS	
Mid-quarter feedback for individual Core courses, faculty, and TAs	More data is good! I think it allows students to reflect on their performance Demonstration of greater concern for students' success. There should be way to get higher/more consistent response rate. Helping with recognizing issues; assess success of future changes. Good opportunity for mentors to make changes. Hard to make changes if don't know the issues, so very helpful! More communication with frosh advisors who attend→ good to communicate info to those who are not here. Data needs to be integrated with academic data. TAs and instructors are now getting feedback for the first time. Extremely helpful for both the instructors and TAs to identify issues while there is still time to change. Marginal. Nothing was out of expectation so little action action; useful if something is out of ordinary. This is very helpful; I think this is a great practice for getting faculty to make adjustments. Enabled changes mid-quarter to address issues – important. Opportunity to adjust and take new approaches. Ability to track student changes within the academic year; more data are always better. Will help with broader assessment efforts at the Institute. Was there any before? This is a key outcome – low-hanging fruit!
Discussing up-to-date data and examples of practices within the Caltech community	Faculty seem engaged; I see few students at these things. I think this is really important, especially at Frosh camp. Increased awareness of and sense of community. Important because it shows we want to improve/help students. Can help to inspire professors to re-assess their own practices. Good summaries for people not as directly involved. [High priority] (though this seems to rely on collecting the data ☺) Our "audience" keeps on changing, so we need to track it. Nice to actually see what's happening. Super helpful for community to see what's happening. Very helpful. Took ideas for m these discussions and implemented in my classes. Improve data presentation (error bars/distributions); give faculty better sense of significance & continue collecting student data. Shining a light on how we're doing – highlighting areas of improvement. Data-informed discussions are great. Having a strategy for what comes next are important. Outcomes still unclear. Hard to assess uptake by faculty.

COMMENTS	
Engaging with external guest speakers/ workshop facilitators on inclusive teaching methods	Very useful for my classes. Always useful. Faculty started to become engaged. Good but maybe not the highest priority. It has been good to have access to people putting the best practices in place. It's helpful to get a sense of what's happening at other institutions and learn from them. Raised awareness of evidence-based teaching among faculty/TAs but unclear how has impacted classroom practices. Were they implemented? A useful supplement to teachWeek, because more distributed throughout the year.
Online materials (e.g., grid of main Core topics by week; syllabus template)	I can see how this would be useful to TAs and Profs, but it could also help sophomore year courses Good for staff who assist students to have context of classes! Very convenient for advisors! Good to integrate intellectual topics within Core; more emphasis on collaboration of topics across classes. The information was easier for students and instructors to find. Good cross-communication between Divisions. Haven't used these.

Inclusive Caltech Core (IC^2)

May 31, 2019 Wrap-up

- Brief project recap
- Making sense of data
- What next?

(and final input for the funder, AAU!)

Questions, discussion?

Thank you!

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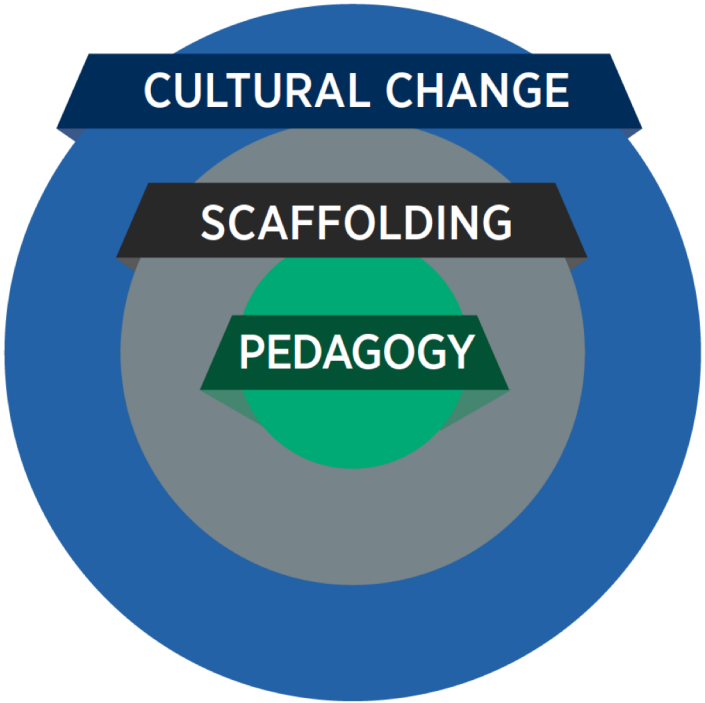
Undergraduate Dean's Office



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FRAMEWORK

FOR SYSTEMIC CHANGE IN UNDERGRADUATE STEM TEACHING AND LEARNING

Inclusive Caltech Core Program and AAU's framework for improving undergraduate STEM Education