BRAID RESEARCH:
UPDATES ON INTRODUCTORY COMPUTING STUDENTS FROM YEAR THREE OF DATA COLLECTION

NOTE: UPDATED NOV 2018

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WHAT IS BRAID?

• Partnership between AnitaB.org, Harvey Mudd College, and UCLA

• Fifteen-campus initiative to promote gender and racial/ethnic diversity in undergraduate computing

• Institutional commitments:
  • Revamping intro courses
  • Promoting interdisciplinary CS
  • Building student community
  • K-12 outreach
PRESENTATION OUTLINE

- BRAID Research Goals and Overview
- A Framework for Assessing “Impact”
- Using Longitudinal Data to Study Persistence in Computing
- Booming Enrollment and Diversity Efforts
- Next Steps: Case Study Project
**BRAID RESEARCH GOALS**

**Phase 1: To document what is happening at BRAID Institutions**
- To what extent are BRAID schools **successful in diversifying**?
- What are **introductory course students** experiencing? What are the impacts of those experiences?
- How does this **vary by gender and race/ethnicity**?
- What is the **role of the department chair** in leading diversity initiatives?

**Phase 2: To examine the experiences of diverse populations 1, 2, and 3 years after enrolling in introductory computing courses at BRAID institutions**
- What **computing environments and experiences** predict gains in desired **student outcomes** in the years after taking the introductory course?
- Are these environments and experiences more **salient for women or URM students**?

**Phase 3: Case studies**
- How do universities maintain and **increase diversity** in computing while also responding to **booming enrollments**?
QUALITATIVE & QUANTITATIVE BASELINE DATA COLLECTION

- Computing Enrollment and Degree Attainment
- Department Chairs
- Introductory Course Instructors
- CS Majors & Minors
- Intro CS Students
QUALITATIVE & QUANTITATIVE BASELINE DATA COLLECTION

Intro CS Students 2015-16
N=4898

Follow-up 1 2016
N=2087

Follow-up 2 2017
N=1882

Follow-up 3 2018

Intro CS Students 2016-17
N=5479

Follow-up 1 2017
N=2325

Follow-up 2 2018

Response rates across surveys range from 34% to 43%
A FRAMEWORK FOR ASSESSING “IMPACT” THROUGH STUDENT SURVEYS

Alexander “Sandy” Astin with the BRAID Research Team
ANALYTICAL FRAMEWORK: ASTIN’S “I-E-O” MODEL

Regression-based modeling used to control for self-selection and identify key environmental predictors
I-E-O IN THE CONTEXT OF COMPUTING: EXAMPLE

Departmental Support

Sense of Belonging in Computing
I-E-O IN THE CONTEXT OF COMPUTING: EXAMPLE

Departmental Support
+ Various other environments/experiences

Sense of Belonging in Computing
I-E-O in the Context of Computing: Example

- **Departmental Support**
  - + Various other environments/experiences

- **Sense of Belonging on Computing** (pre-test)
  - + Various other inputs

- **Sense of Belonging in Computing**
I-E-O ACROSS BRAID RESEARCH

**Student Inputs**
Gender, race, parents' ed/career, prior computing experiences, life goals, self-confidence, etc.

**Computing Environment**
Exposure to “BRAID Commitments”, Major/minor, intro course experiences, out-of-class computing experiences, departmental support, etc.

**Computing Outcomes**
Persistence, degree attainment, career choice, GPA, computing self-confidence, etc.
ANALYTICAL FRAMEWORK: “CONDITIONAL” I-E-O MODEL

How do effects of college vary for different groups of students?
ANALYTICAL FRAMEWORK:
“CONDITIONAL” I-E-O MODEL

How do effects of college vary for different groups of students?
I-E-O & THE BRAID
LONGITUDINAL DESIGN

Environment Year 1

Inputs
(Start Intro Course)

Outcomes
(End Intro Course)

Environment Year 2

Outcomes
(Follow-up 1)

Environment Year 3

Outcomes
(Follow-up 2)

Etc…
### COMPUTING TOPICS CURRENTLY EXPLORED IN BRAID RESEARCH

<table>
<thead>
<tr>
<th>Key Inputs/Populations</th>
<th>Key Environments</th>
<th>Key Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Undecided Students</td>
<td>Intro Course Pedagogy</td>
<td>Computing Persistence</td>
</tr>
<tr>
<td>Latecomers to Computing</td>
<td>Out-of-Class Computing Engagement</td>
<td>Computing Career Plans</td>
</tr>
<tr>
<td>At-risk Computing Majors</td>
<td>Departmental change efforts</td>
<td>Sense of Belonging in Computing</td>
</tr>
<tr>
<td>Interdisciplinary (CS + X) Students</td>
<td>Enrollment Boom and Diversity Efforts</td>
<td>Computing Confidence</td>
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<tr>
<td>Etc.</td>
<td>Etc.</td>
<td>Etc.</td>
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</tbody>
</table>

...all topics explored with a focus on role of gender and race/ethnicity
To what extent do computing majors persist? What factors promote persistence?

Zach Lehman,
Games Director

2005
Transferred & Changed to Business Major

2006
Transferred & Changed to English Major

2007
Transferred & Changed Major to Art

2009
Transferred & Changed Major to Computer Science

2012
Completed BS in Computer Science
CONSIDERATIONS WHEN MEASURING PERSISTENCE

Defining Persistence

• Computing Persister: Student who reported that they had at least one computing major at the end of the intro CS course and *still reported at least one computing major* at the time of the second follow-up

• Computing Leaver: Student who reported that they had at least one computing major at the end of the intro CS course and *reported having no computing majors* at the time of the second follow-up

Sample Restrictions

• First and Second year students at the time of the intro class
Non-STEM Major + Computing Minor on Follow-Up 2

Other STEM Major + Computing Minor on Follow-Up 2

Other STEM Major

Computing Major in Intro Course (N=548)

(Non-STEM Major) 88% (N=480)

(Other STEM Major) (N=37)

(Other STEM Major) (N=19)

(Non-STEM Major) + Computing Minor on Follow-Up 2 (N=9)

(N=548)
# PREDICTORS OF COMPUTING PERSISTENCE

<table>
<thead>
<tr>
<th>Input Variables</th>
<th></th>
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<tbody>
<tr>
<td>Student Gender: Female</td>
<td>-</td>
</tr>
<tr>
<td>Socioeconomic Status</td>
<td>-</td>
</tr>
<tr>
<td>Computing Self-Concept</td>
<td>+</td>
</tr>
<tr>
<td>Academic Self-Concept</td>
<td>-</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Variables</th>
<th></th>
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<tbody>
<tr>
<td>Instructor Responsiveness</td>
<td>+</td>
</tr>
<tr>
<td>Reliance on Peers</td>
<td>-</td>
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</tbody>
</table>
Computing Pathways

Entering Computing Majors

Front Door

52.8
Computing Majors

41.5
Other Majors

5.7
Undecided

Intro Computing Students, By Major

CS+X: Women who major in computing are twice as likely as men to have a double major

Side Door

Latecomers: 1/3 of women take an Intro CS course in their 3rd year or later

Undecided: Women are significantly more likely than men to take an intro CS course as an undecided major
Booming Enrollments + Diversity Efforts: Lessons from 2018 Department Chair Interviews
ENROLLMENT TRENDS: BOOM IN CS STUDENTS

Enrollment Growth Effects:

- Very large class sizes
- Increased workload for instructors & hiring
- Limited student data

“We have an on-campus residential high school that's added about 80 more students a year to our intro classes.”

“Our State has had massive education cuts and tuition freezes, so they want to admit more people than we might be tempted to. They want us out of the loop of Admissions.”
“We have zero influence on undergrad admissions, we have no control. If they said: ‘Okay, you can control things’ - and all they gave us was a crude instrument like increasing the cut-offs for ACT scores or the GPAs - that would be terrible for diversity and inclusion. **We wouldn't do it; I wouldn't do it, as department chair.**"
# ADMISSIONS: WE DON’T HAVE A WAY TO SHAPE OUR CLASS

<table>
<thead>
<tr>
<th>Level</th>
<th>Category</th>
<th>Factors</th>
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<tbody>
<tr>
<td>Macro</td>
<td>External</td>
<td>- Economy</td>
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<tr>
<td></td>
<td></td>
<td>- Regional and local context / demographics</td>
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<tr>
<td></td>
<td></td>
<td>- Institutional characteristics</td>
</tr>
<tr>
<td>Meso</td>
<td>Institution</td>
<td>- Enrollment pressures</td>
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<tr>
<td></td>
<td></td>
<td>- Budget / resources and bureaucratic processes</td>
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<tr>
<td></td>
<td></td>
<td>- Diversity initiatives</td>
</tr>
<tr>
<td>Micro</td>
<td>CS Dept</td>
<td>- Limited direct influence</td>
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<tr>
<td></td>
<td></td>
<td>- Communicating with admissions</td>
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<tr>
<td></td>
<td></td>
<td>- Targeted outreach post-admissions</td>
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Booming Enrollments + Diversity Efforts: Initial Findings from Institutional Enrollment Data
HOW MUCH HAVE BRAID INSTITUTIONS INCREASED ENROLLMENTS AMONG WOMEN AND URM STUDENTS?

- Computing enrollments at BRAID institutions up 31% between 2014-2017
- 51% increase in women’s enrollment
- 31% increase in URM enrollment
- What is variation among BRAID institutions?
Women’s Enrollment Growth vs. Overall Enrollment Growth in All Computing Majors at BRAID Institutions (2014-2017)

Sample institution X: Up 56% among women, up 38% overall
Overall Enrollment Growth vs. Women’s Enrollment Growth in All Computing Majors at BRAID Institutions (2014-2017)

“Above the line” = Women’s enrollment growth outpaces total enrollment growth

“Below the line” = Total enrollment growth outpaces women’s enrollment growth
Overall Enrollment Growth vs. URM Enrollment Growth in All Computing Majors at BRAID Institutions (2014-2017)

“Above the line” = URM enrollment growth outpaces total enrollment growth

“Below the line” = Total enrollment growth outpaces URM enrollment growth
Next Steps: Case Study Project
RESEARCH QUESTIONS & DATA SOURCES

1. How are various stakeholders responding to the CS enrollment boom?
2. How do institutional policies align with departmental efforts to increase participation of women and URM students in CS majors?
3. What strategies are the departments using to improve retention of women and URM students in CS majors in the context of the booming enrollments?

- Department chairs, students, teaching assistants, admissions officers, student affairs professionals, introductory course instructors, etc.
- Institutional data, baseline data, follow-up data
- Introductory course, upper level course, student group meeting, recruitment/admissions event, faculty meeting
- IPEDS, other national or comparative data sources
THANK YOU!

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BRAID RESEARCH IN BRIEF