Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

By Dr. Erik K. Dutilly | May 8th, 2019 | Erikdutilly@gmail.com

Graduate of University of Colorado-Boulder's School of Education

Western Institute for Education Evaluation and Consulting | www.western-eval.com

Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

Presentation Overview

- Introduction
- My interest in the topic
- General importance of topic
- Why selection is a moral nerve center
- Defending broadening participation in undergraduate research
- An empirical study of selection at one government lab
- Practitioner recommendations

Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

El Potrero Chico, Mexico

Cooking

My eldest cousin on a trip to Aspen, Colorado.

Early Seeds of Interest

Storm front over Adelaide, AU

Details of a snowflake

Northern Lights

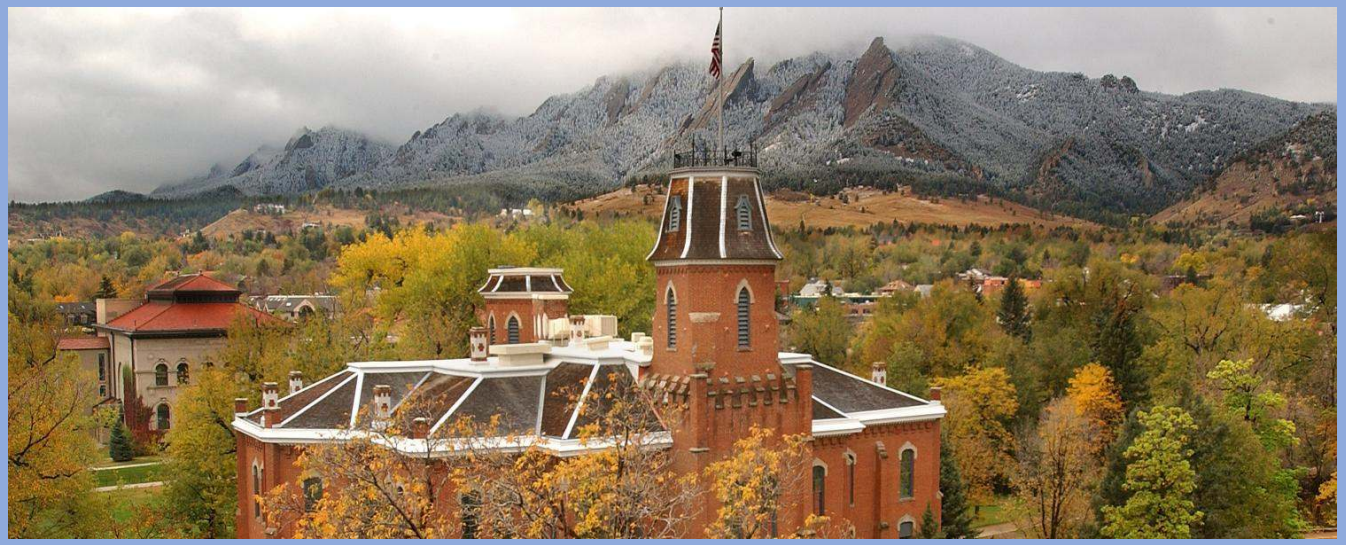
Early Seeds of Interest

Cathedral of Quito, Ecuador

Deforestation in the Andean cloud forest

Pichincha Volcano near Quito

My Dissertation Topic in One Slide



University of Colorado-Boulder Campus in fall

Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

How should we and how do we recruit and select students for scarce and valuable STEM learning and training opportunities?

Why should we worry about this topic?

Comparing Acceptance Rates

Highly selective universities

Harvard University

5.4% admissions rate (2016-2017)

Stanford University

4.8% admissions rate (2016-2017)

CalTech

8.1% admission rate (2016-2017)

Convenience sample of UR programs/internships

1st and 2nd Year of my Dissertation Site

9% (2013) and 6.5% (2014)

Beninson el al (2011) study of REU Bioscience

6.7% (2008) and 5.9% (2009)

Why should we worry about this topic?

Affirmative Action and Broadening Participation

Affirmative Action and Harvard University

Recently taken to court over its Affirmative action policies and practices

Broadening Participation

Scholars, NSF, and NIH folks have been calling for Broadening Participation for the last few decades, a practice analogous to affirmative action.

Why should we worry about this topic?

Participation in undergraduate research programs and internships causes students to want to attend graduate school.

		Highest Degree Aspirations		
Bachelors:	Pre-REU	18	26	21
		-15%	-21%	-19%
	Post-REU	3	5	4
Masters:	Pre-REU	16	17	16
	Post-REU	19	19	19
PhD or DSc:	Pre-REU	48	41	45
		+10%	+14%	+12%
	Post-REU	58	55	57

Fortenberry, 1990, p. 15

Why should we worry about this topic?

Summary

1) STEM undergraduate training programs are competitive

2) Affirmative action is analogous to broadening participation.

3) Programs have been evaluated as effective or not based on portion of alumni enrolled in graduate school

Many students who participate in UR and internships already intend to go to graduate school

Internship vs. Undergraduate Research

Internship

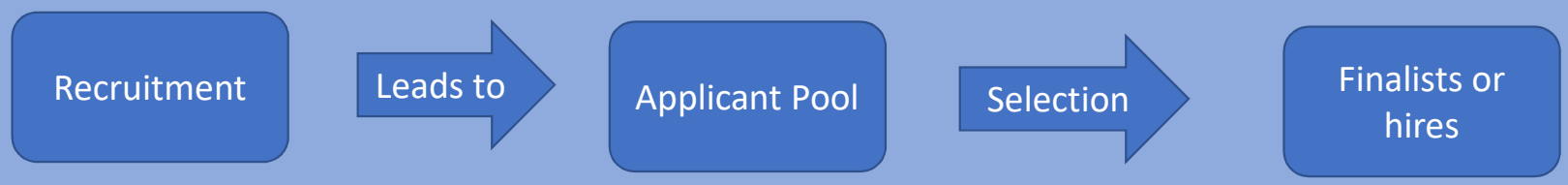
- Research component
- Can last a summer or a school year
- Mentored experience
- Likely to have a paper or poster sessions
- Work life will reflect environment
- Likely in laboratories or industry
- Focus on pragmatic issues related to work
- Probably more common for applied fields like engineering and computer science

Undergraduate Research

- Research intensive and purposeful
- Can last a summer or a school year
- Mentored experience
- Likely to have a paper or poster sessions
- Work life will reflect environment
- Likely in universities or museums
- Focus on basic or experimental research
- Focus on original discovery/contribution

Part II – Understanding Recruitment and Selection

Part II – Understanding Recruitment and Selection

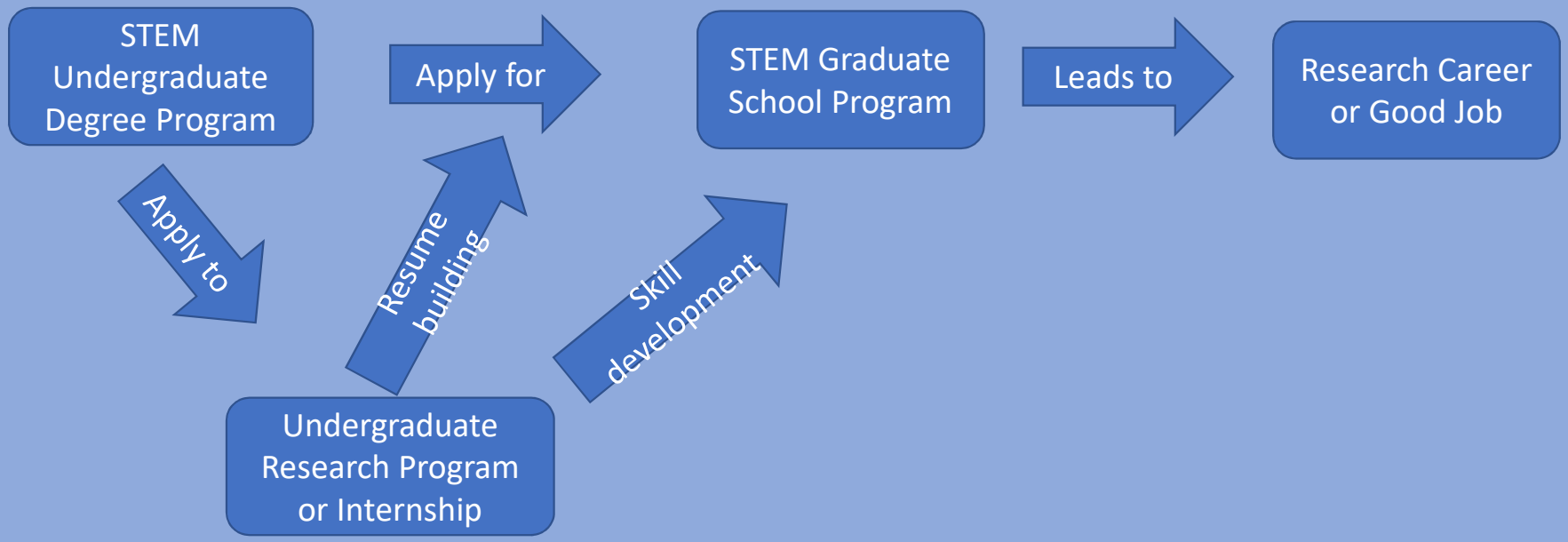


Raise Awareness and Advertise

Collect many applicants

Few left

Part II – Understanding Recruitment and Selection



Part II – Understanding Recruitment and Selection

Seasonal Cycle of Recruitment and Selection

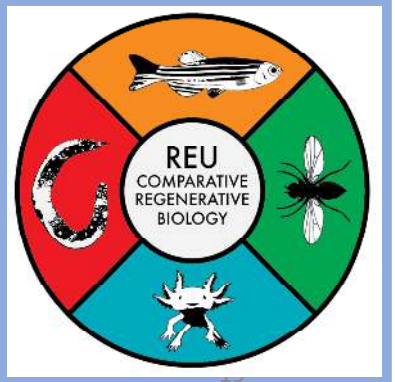
- Recruitment can last from November to February
- Selection last until April
- Students will usually accept summer positions around early May

Part III - Student Recruitment and the REU Program

Recruitment Practices in the REU Program

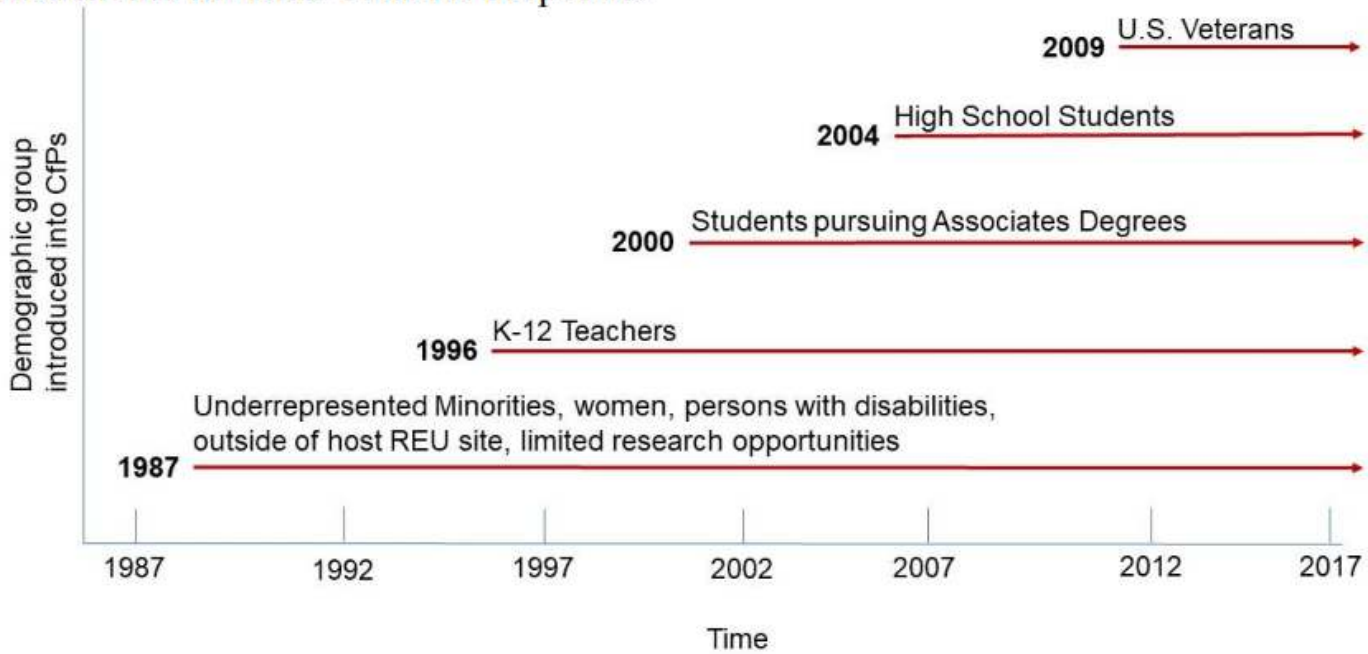
What is the REU Program?

- National Science Foundation funding stream or program
- Supports three-year competitive grants to institutions
- Grant money creates programming for undergraduate research at appropriate sites
- Commonly are 10-week summer programs
- Commonly 8-10 students participate at an institute
- Student airfare, lodging, programming, and a stipend are included
- Strong research skill development emphasis
- All major NSF directorates participate but at different rates (BIO, ENG, MPS, etc)



Recruitment Practices in the REU Program

Figure 2.1. Demographic recommendations for selection and recruitment, by year of introduction into the REU Calls for Proposals.



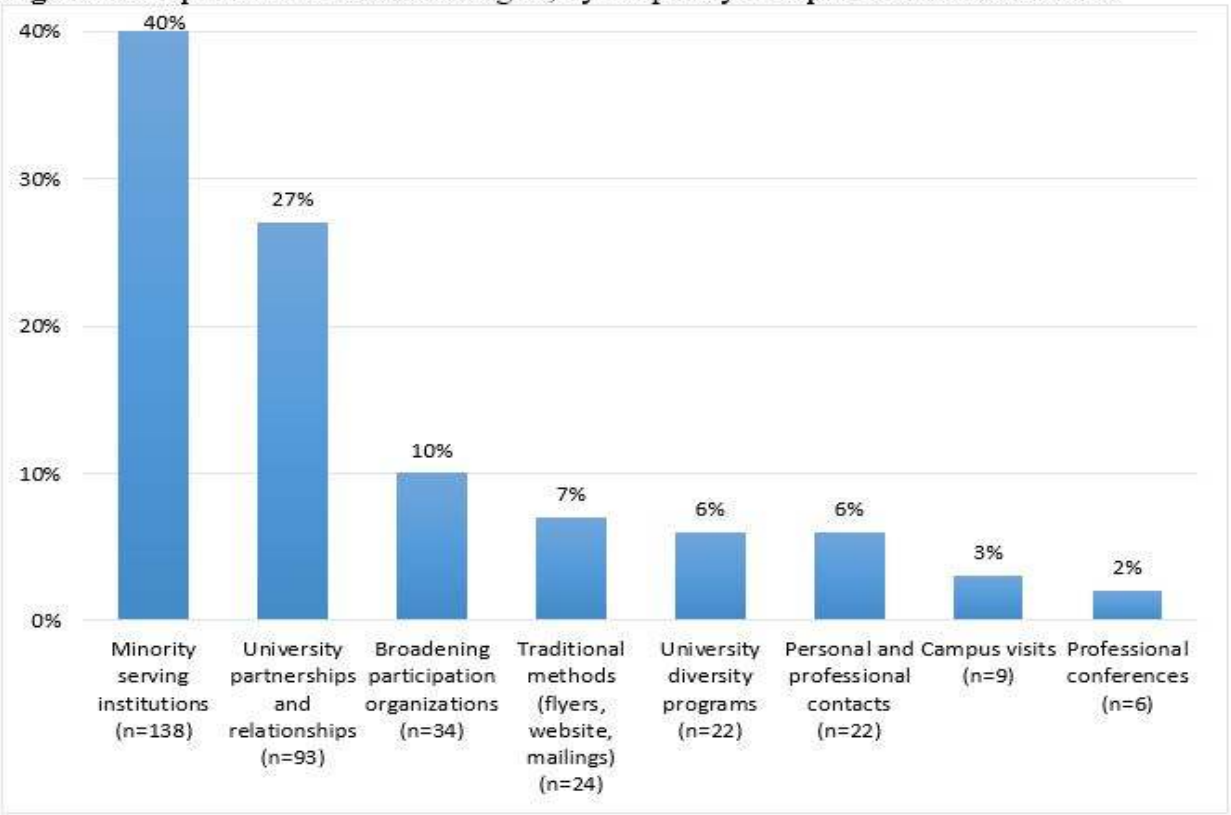
Recruitment Practices in the REU Program

Table 2.2. Descriptive statistics for REU award sites and years included in this study, by year.

Year of REU awards included	Newly funded REU sites	Number of Abstracts	Percent of missing abstracts	Abstracts with recruit/select statements	Percent of abstracts missing recruit/select
1987	170	123	38%	26	79%
1990	152	148	3%	36	76%
1995	82	82	0%	42	49%
1999	125	121	3%	67	45%
2000	125	124	1%	67	46%
2001	144	144	0%	102	29%
2003	169	169	0%	124	27%
2006	172	172	0%	98	43%
2008	151	151	0%	99	34%
2014	187	187	0%	166	11%
2017	216	216	0%	165	24%
Mean	154	149	4%	90	41%
Stand Dev	36	37	11%	48	21%
Total	1506	1450	-	826	-

Recruitment Practices in the REU Program

Figure 1. Proposed recruitment strategies, by frequency of representation in the data.



Note: This figure contains a frequency count of the number of mentions of unique recruitment strategies across all eleven years included in this study.

Part IV – Selection in Theory

Recruitment Practices in the REU Program

Merit

Diversity

Disadvantage

Lottery (strict equality)

Recruitment Practices in the REU Program

Merit

Diversity

Disadvantage

Lottery (strict equality)

Recruitment Practices in the REU Program

Merit

Diversity

Disadvantage

Lottery (strict equality)

Recruitment Practices in the REU Program

Meritocracy

- Qualifications
- Education
- Test Scores
- Past accomplishments
- Previous research experiences
- Professor recommendations
- Grade Point Averages

Broadening Participation

- Underrepresentation
- Diversity of team members
- Compensation for discrimination
- Fairness as sharing jobs
- Biases in measures of merit

Justifying Broadening Participation

What is Broadening Participation?

- Members of historically underrepresented groups (historically and current low levels of participation) in science fields

- Demographic diversity is a proxy for intellectual diversity

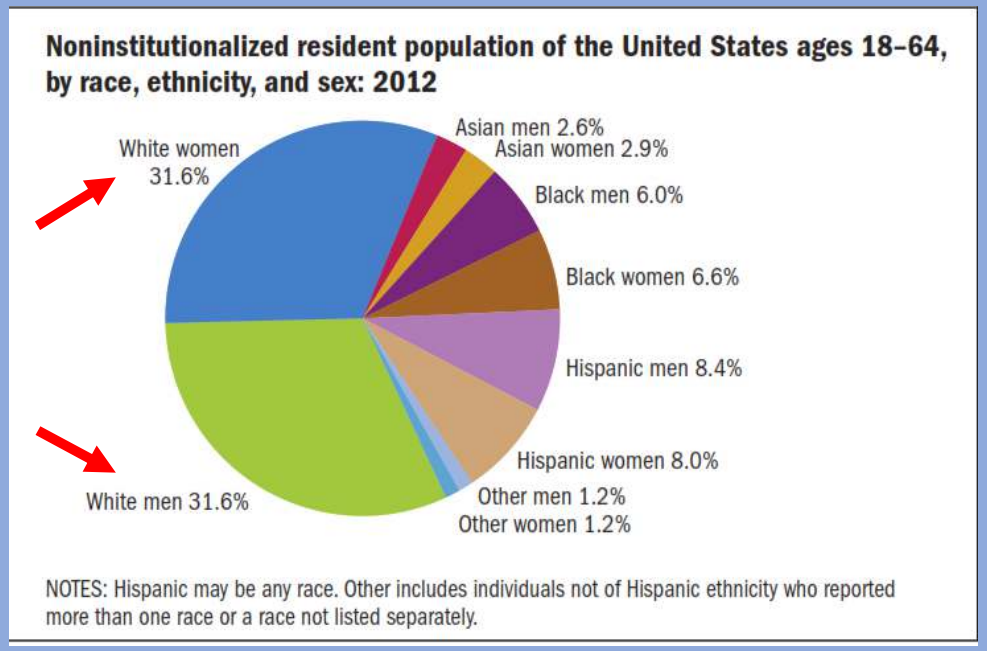
- Intellectual diversity leads to discovery and innovation

- A workforce strategy

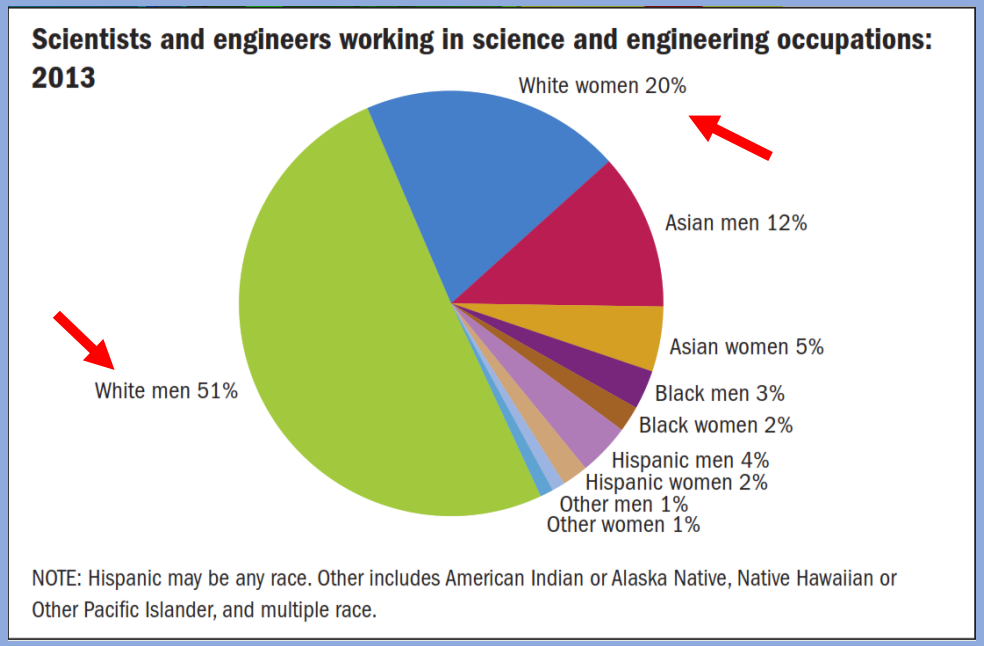
NSF, 2008

Justifying Broadening Participation

National population by demographic group



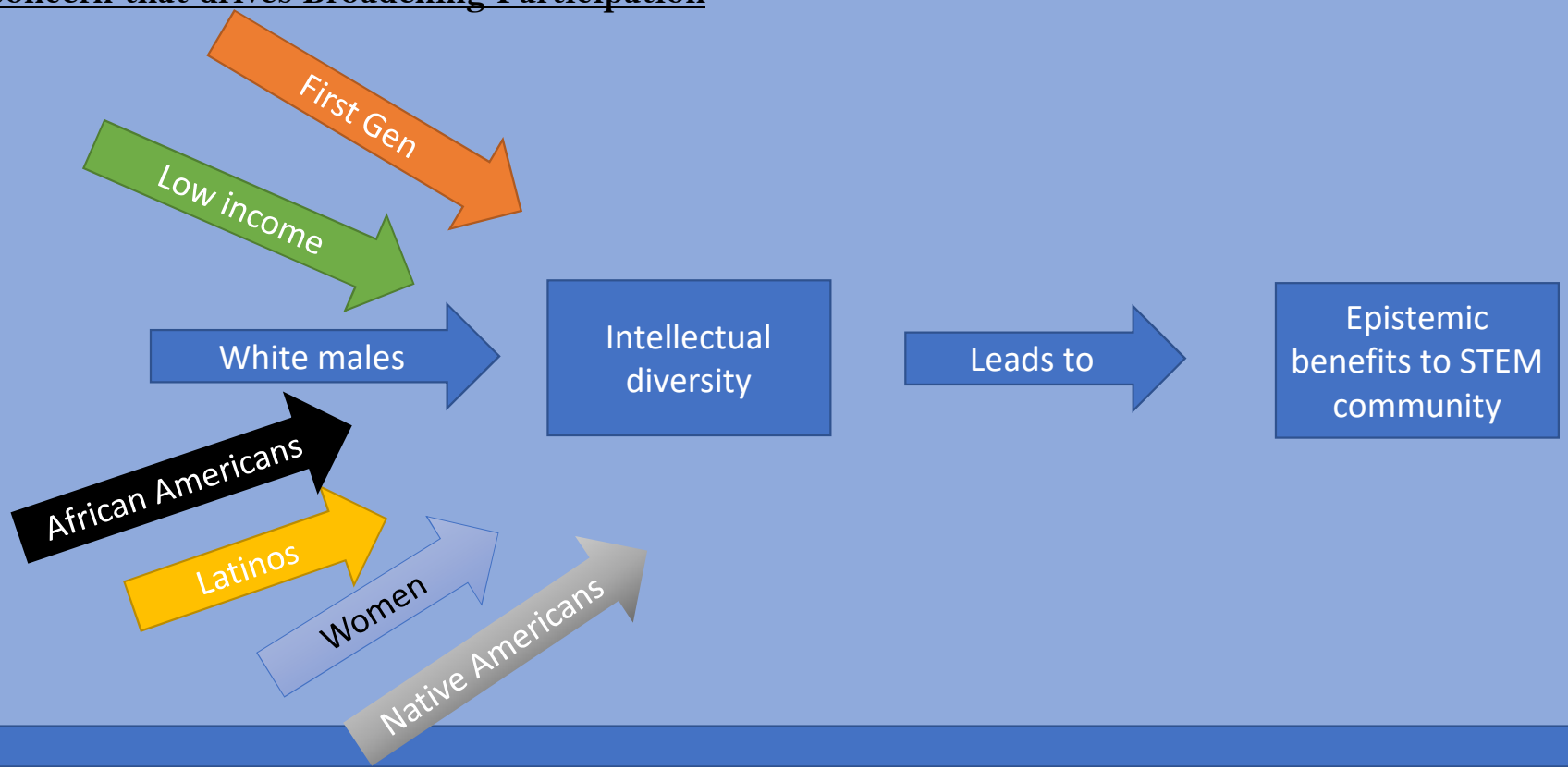
Working scientists and engineers by demographic group



NSF, 2015

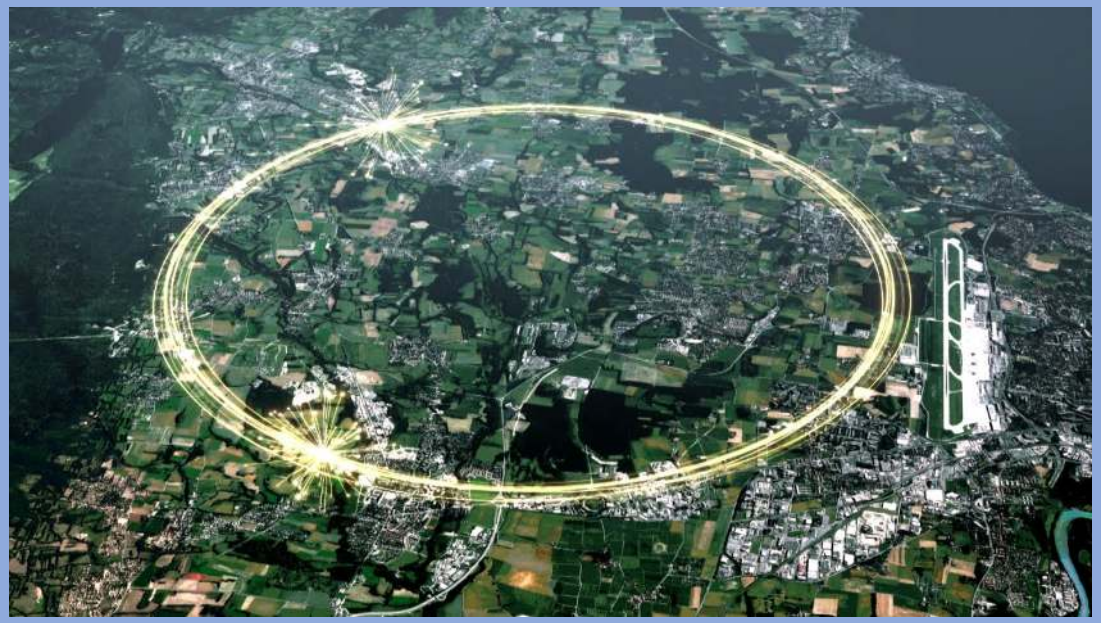
Justifying Broadening Participation

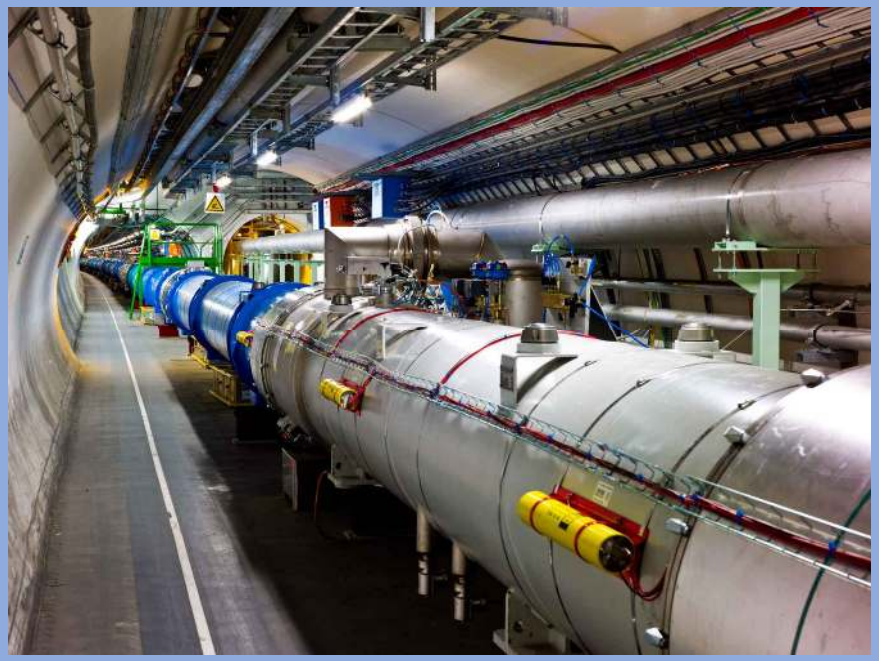
One concern that drives Broadening Participation



Justifying Broadening Participation

Pictures of the CERN Hadron Collider

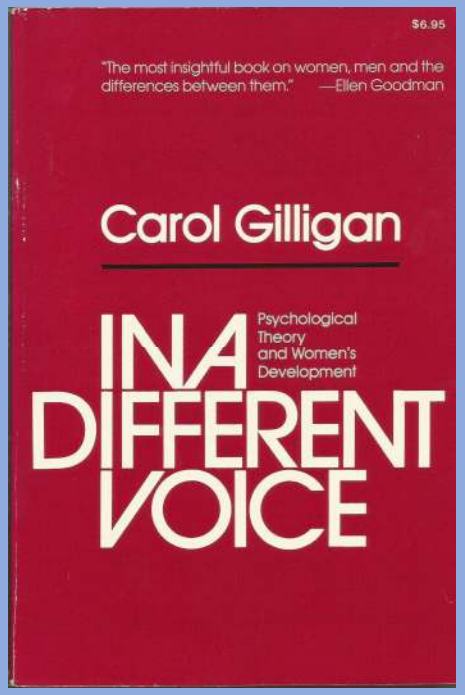




Justifying Broadening Participation

While men represent powerful activity as assertion and aggression, women in contrast portray acts of nurturance as acts of strength.

~ Carol Gilligan



Justifying Broadening Participation

Applying the argument to Undergraduate Research and Internships

- Undergraduate research programs are an investment in the future of Science.
- If it is good for the scientific community to have diverse members, then it is good for developmental programs to train these students.
- Students from underrepresented groups ought to be a portion of the participants in these programs because their unique experiences and interest are likely to produce innovation in their fields.
- STEM undergraduate research programs and internships are a **real currency** in the scientific community and selecting these students gives them a boost toward research careers.

NSF, 2015

Justifying Broadening Participation

Quick Summary

- Broadening participation proposes diversifying the workforce
- Demographic diversity is a proxy for special kind of intellectual diversity
- Intellectual diversity is good for the scientific community (correct biases, new research questions, interdisciplinary approaches)
- Therefore, one good idea for Science is to diversity its members

Part V – Selection in Practice

Selection Practices in a Federal Laboratory

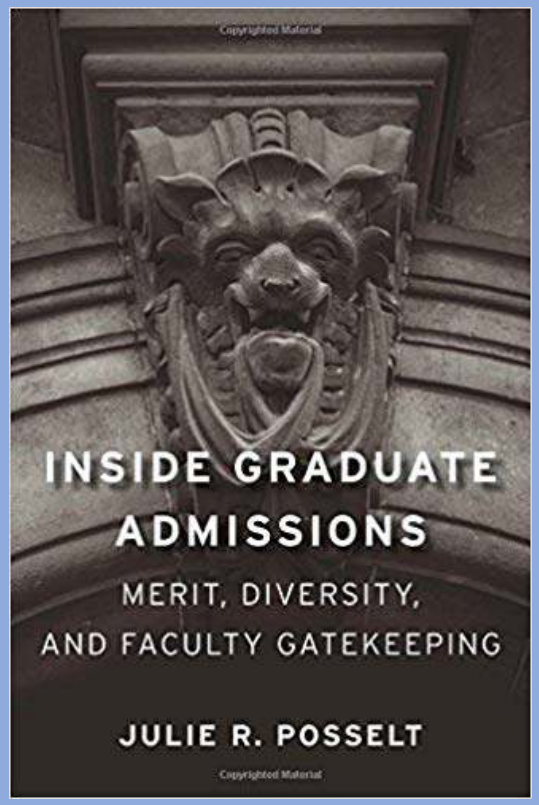
Meritocracy

- Qualifications
- Education
- Test Scores
- Past accomplishments
- Previous research experiences
- Professor recommendations
- Grade Point Averages

Broadening Participation

- Underrepresentation
- Diversity of team members
- Compensation for discrimination
- Fairness as sharing jobs
- Biases in measures of merit

Selection Practices in a Federal Laboratory



Dr. Julie R. Posselt

Selection Practices in a Federal Laboratory

Merit	Diversity Status
Fit	

Selection Practices in the REU Program

Selection Practices in the REU Program

Merit	Diversity Status
Fit	"Need"

Selection Practices in the REU Program

What about broadening participation?

Part VI – Practical Recommendations

Practical Recommendations

1) Use recruitment strategically

2) Populate interview and selection protocols with your values

3) Discuss merit, diversity, disadvantage, and need

4) Tinker with various models for selection

5) Biases may not be unconscious

Student Selection and Recruitment into STEM Undergraduate Internships and Research Programs

By Dr. Erik K. Dutilly | May 8th, 2019 | Erikdutilly@gmail.com

Western Institute for Education Evaluation and Consulting | www.western-eval.com

Recommended Readings

Laursen, S., Hunter, A. B., Seymour, E., Thiry, H., & Melton, G. (2010). *Undergraduate research in the sciences: Engaging students in real science*. John Wiley & Sons.

Posselt, J. R. (2016). *Inside graduate admissions*. Harvard University Press.

Rivera, L. A. (2016). *Pedigree: How elite students get elite jobs*. Princeton University Press.

Sher, G. (1979). Effort, ability, and personal desert. *Philosophy & Public Affairs*, 361-376.

Ideas for Studies

1) Taking the recruitment study from the proposals and using the taxonomy in a survey study to check with sites about what they actually do in recruitment, success, and challenges.

2) More akin to economics – get a sense of the level of competition in REUs by different NSF directorates. Survey study emailing Pis directly. Beninson et al 2011

3) Mapping out the entire selection process for BP purposes. Where do gross cuts occur? Based on what? Where to more refined cuts take place? Where do some criteria emerge as most salient? Centralized vs. decentralized selection processes.

4) Looking at tension or lack thereof between merit views and broadening participation
within organizations and how program directors navigate this.

5) Tendency to silo these UR and internships by organizations (NSF, universities, labs) but in reality there are many commonalities.
Link NIH and NSF UR projects by activities and structure and purpose.

6) No one looks at the active role that students play. They're active in so far as choosing opportunities, applying to many opportunities, passing information about them along inform networks.
How can this active role be explored and how can this active role be placed into context with sites (e.g., inching acceptances closer to April, accepting 10% more students, viewing themselves as higher or lower status than other programs)