Lessons Learned from Research about the Fundamentals of Mentoring STEM Graduate Students

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THREE MAGIC LETTERS

GETTING TO PH.D.

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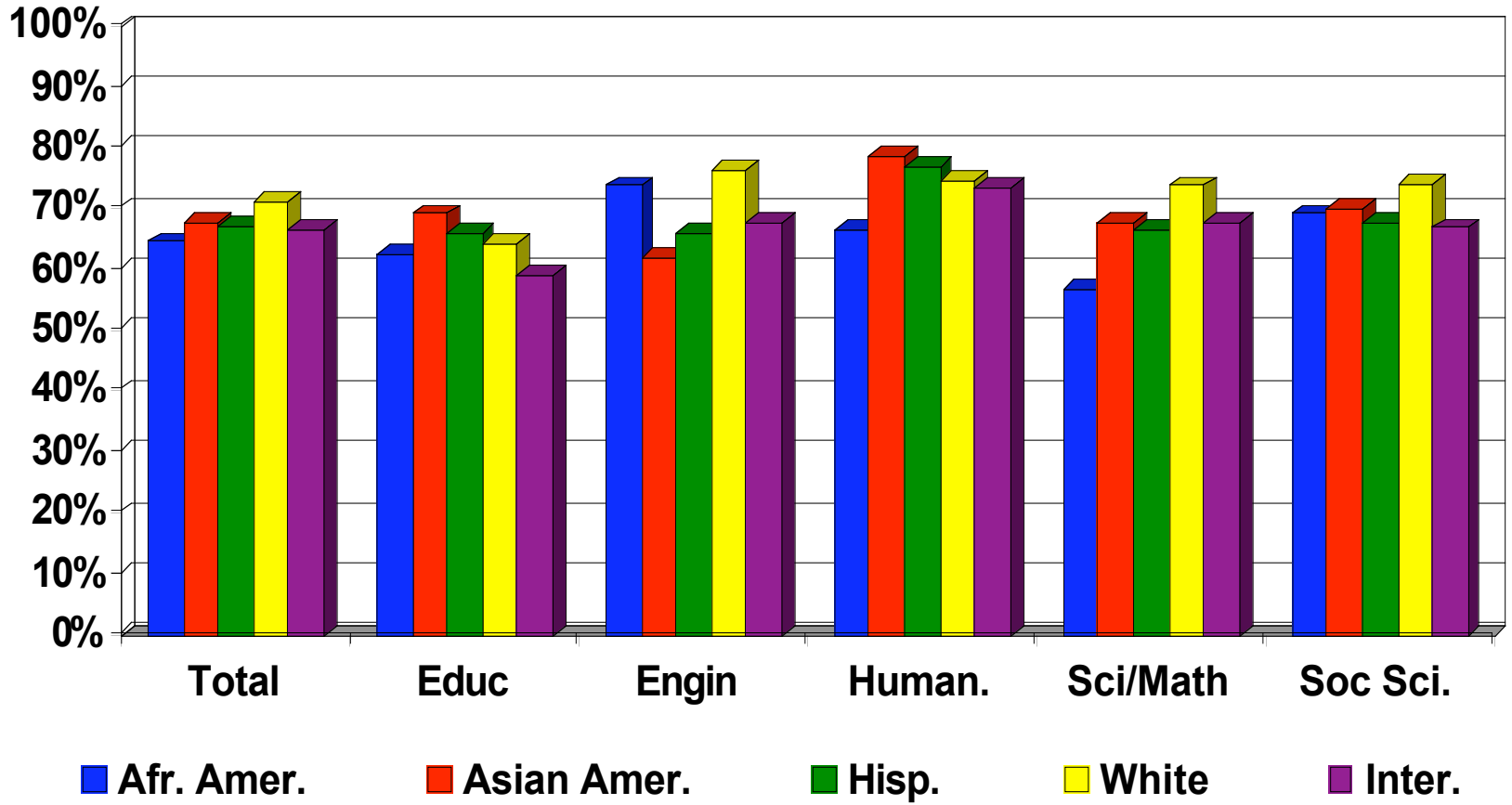
Survey of Doctoral Student Finances, Experiences and Achievements
Three Stage Sampling Plan

- Stage 1 - selected 21 diverse doctoral granting universities
- Stage 2 - selected 11 fields of study
- Stage 3 - selected a stratified sample of 13,160 doctoral students who completed at least one year of study and who were taking at least 6 credit hours in the fall term 1996
  - 9,036 students completed surveys (70% response rate)

Source: Nettles & Millett, Survey of Doctoral Student Finances, Experiences and Achievements

Nearly 70% of Doctoral Students Have a Mentor

- African American students having a faculty mentor is significantly different from White students overall and in Science & Math.
- Hispanic students do not differ from White students in the overall or within fields.



Source: Survey of Doctoral Student Finances, Experiences and Achievements.

What admission characteristics predict having a mentor?

- In engineering, race/ethnicity, parental socio-economic status and performance on the Verbal section of the GRE influence the odds of having a mentor.
- In science/mathematics, race/ethnicity, parental socio-economic status, performance on the Verbal section of the GRE and the type of graduate school influence the odds of having a mentor.

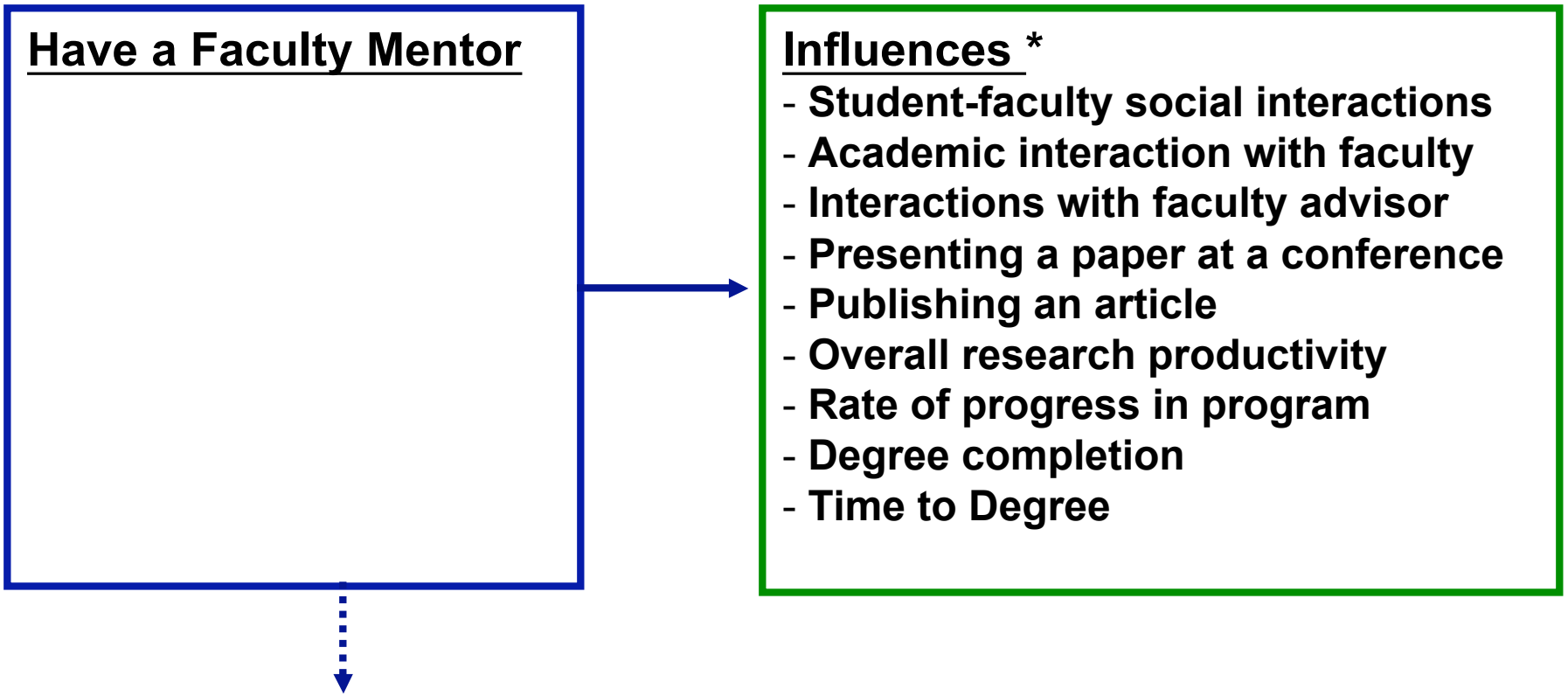
	Educ.	Engin.	Human.	Science/ Math	Social Science
Male			-		
African-American				-	
Hispanic-American					
Asian-American		-			
International	-	-			
Parents' SES		+		+	+
GRE Verbal (100 pt)		-			
GRE Quant (100 pt)				-	
Private grad school	-			-	

Negative signs = less likely to have been had a faculty mentor.

Positive signs = more likely to have had a faculty mentor.

Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Having a Mentor Can Influence Other Doctoral Experiences

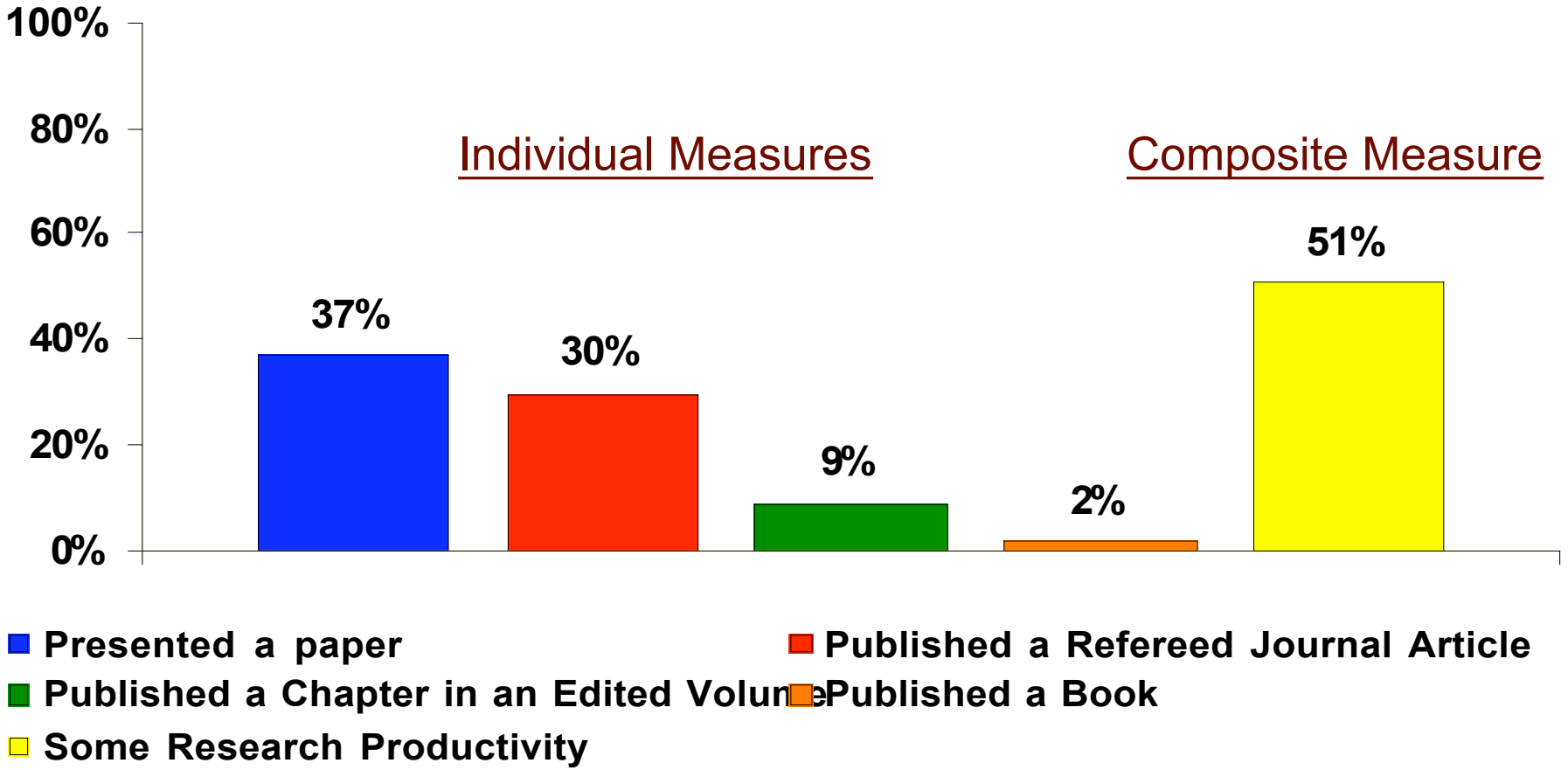


* Note: Influences may not be in all fields

Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Doctoral Students Reports of Achieving An Individual Measure at Least Once

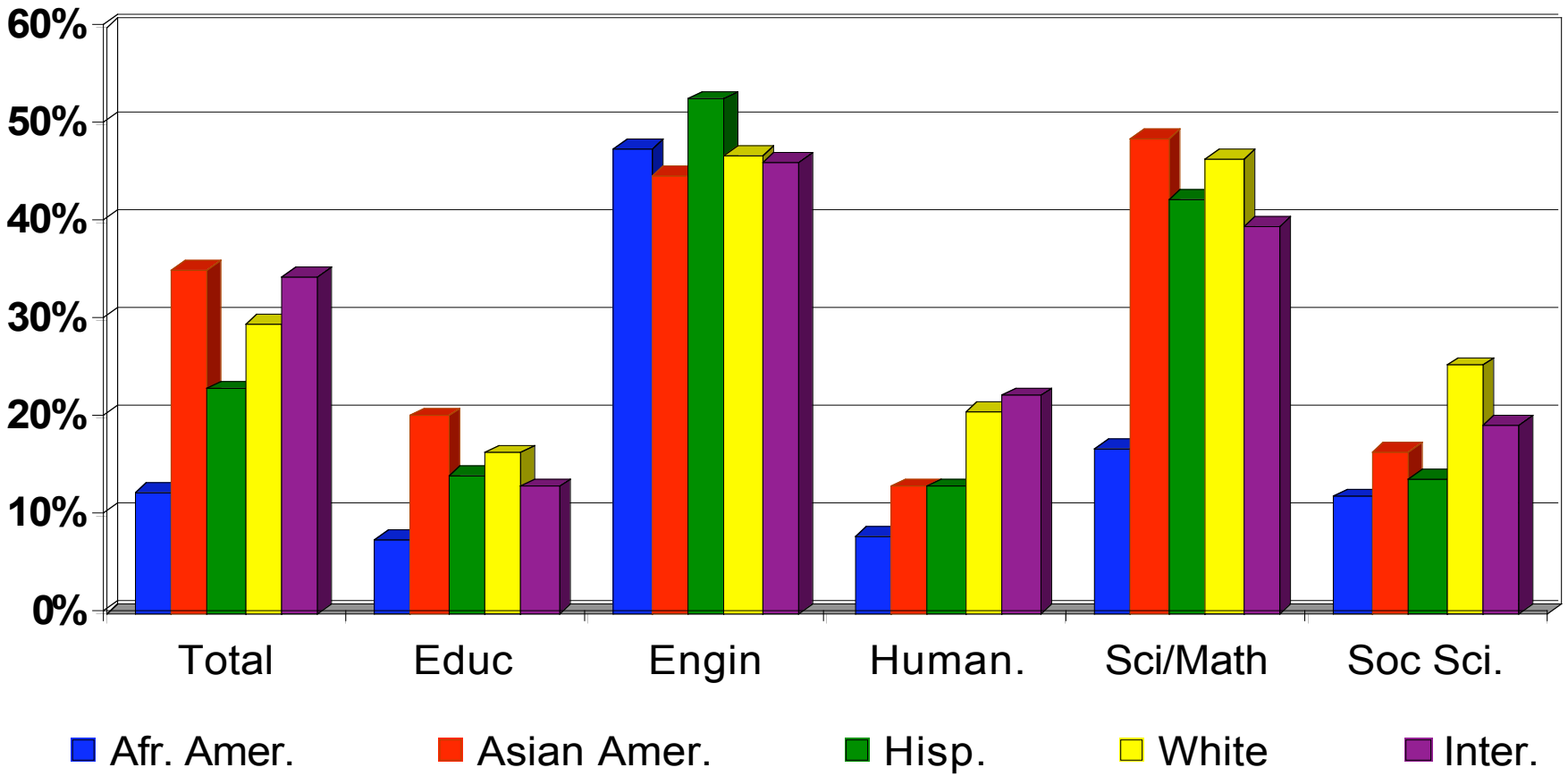
- Created a composite measure that captures whether a student achieved at least one of the individual measures once.



Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Doctoral Students are Publishing Refereed Journal Articles (sole or joint authored)

- African American & Hispanic students rates of publishing an article are significantly different from Whites in the total.
- Within fields, African American students differ from White students in education, science & math, and the social sciences.
- Within fields, Hispanic students do not differ from White students.



Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Being a Research Assistant and Mentoring Positively Influence Article Publication

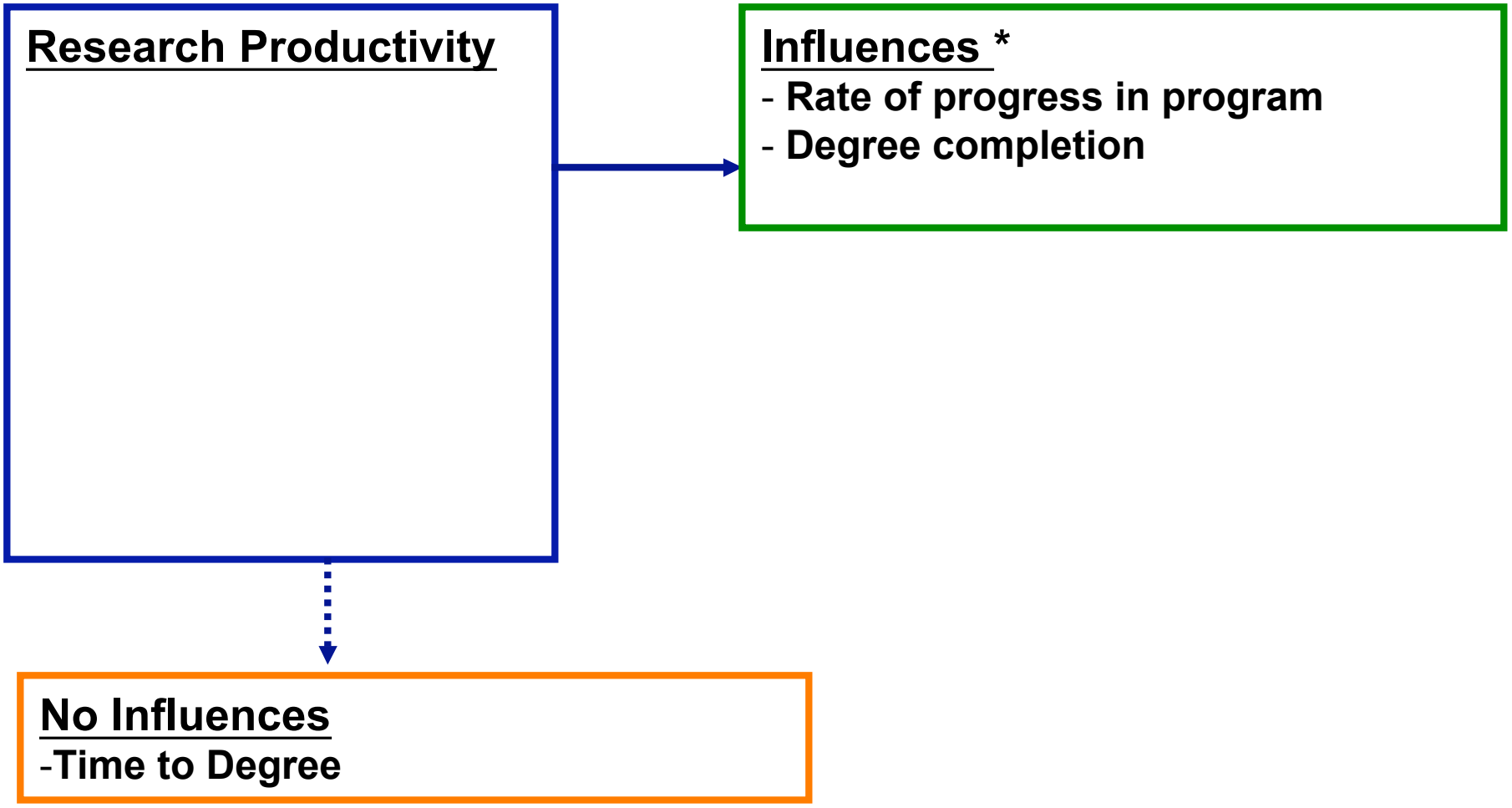
	Educ.	Engin.	Human.	Science/ Math	Social Science
Male		+		+	
African-American	-			-	-
Hispanic-American					-
Asian-American					
International					
Private grad. school	-			+	
Research assistant	+	+		+	+
Teaching assistant	+		+	-	
Has a mentor	+	+		+	+
Time in program	+	+	+	+	+
First job fac./postdoc	+				+

Negative signs = less likely to have written a refereed journal article.

Positive signs = more likely to written a refereed journal article.

Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Research Productivity Can Influence Other Doctoral Experiences

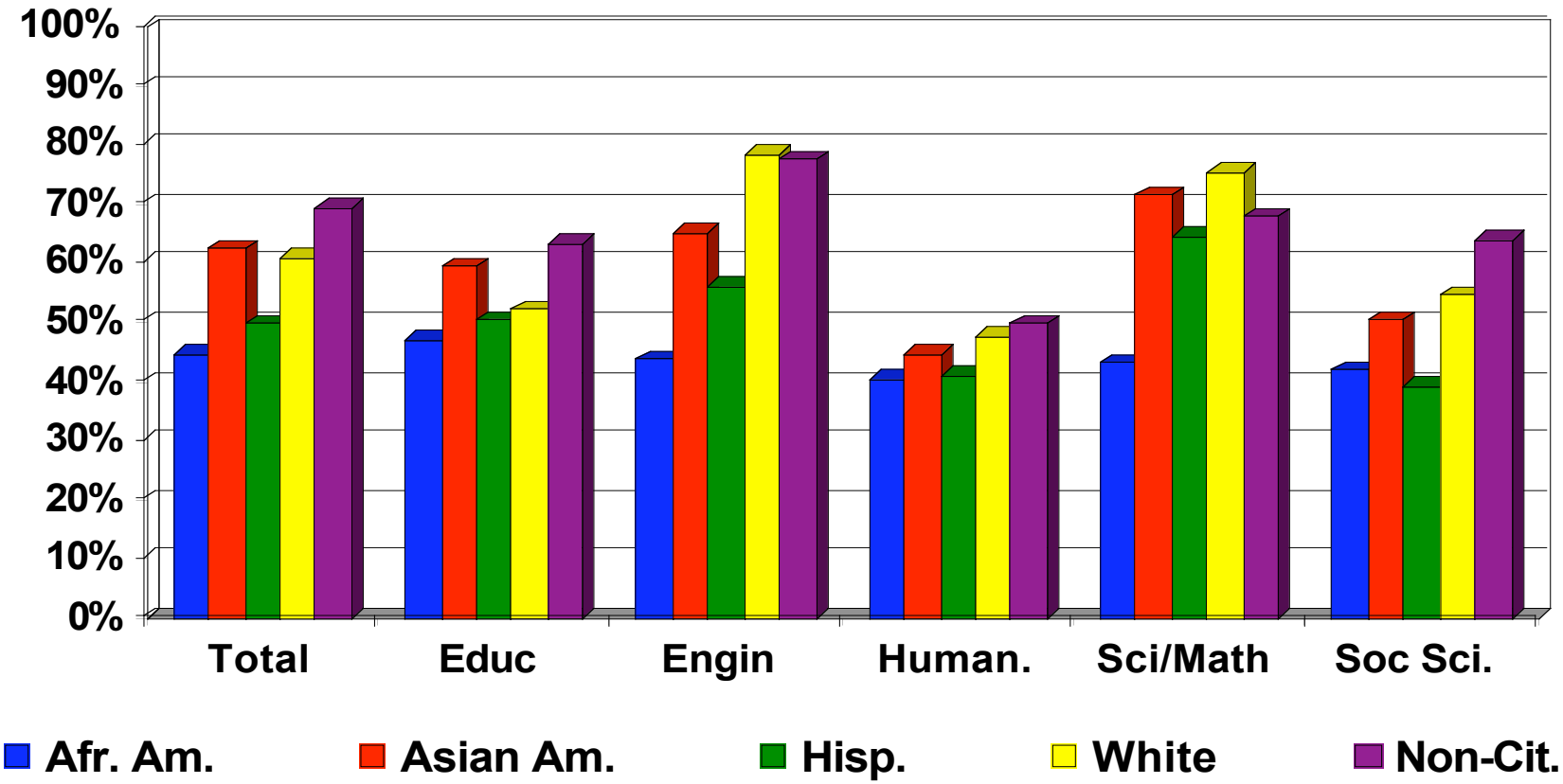


*** Note: Influences may not be in all fields**

Source: Survey of Doctoral Student Finances, Experiences and Achievements.

A Snapshot in Time:
Doctoral Degree Completion by 2001 for Students Beyond the First Year

- African American & Hispanic students degree completion rates are significantly different from White students in the total.
- Hispanic students differ from White students in engineering.
- Afri. Amer. students differ from White students in engineering, science & math, & soc sci.



Source: Survey of Doctoral Student Finances, Experiences and Achievements.

Completing a Doctoral Degree by 2001

- Research productivity is a positive contributor in every field.
- Being married/partner positively influences completion in engineering and science/math.
- Hispanic and African American students differ from White students in engineering.

	Educ.	Engin.	Human.	Sci./Math	Soc. Sci
Male					
African-American		-			
Hispanic-American		-			-
Asian-American		-		-	
International					+
Married/ Partner	+	+		+	
Always full-time	+		+	+	+
Teaching assistant	+		+		
Research assistant				+	
Has a mentor	+	+			+
First job fac./postdoc	+			+	+
Research productivity	+	+	+	+	+

Negative signs = less likely to have completed their doctoral degrees.

Positive signs = more likely to have completed their doctoral degrees.

Source: Nettles & Millett, Survey of Doctoral Student Finances, Experiences and Achievements.

Questions for AAAS/NSF/AGEP and the Nation

- What experiences should all engineering graduate students have?
- What broad skill sets should graduates have and be able to use?
- How well do we understand what entering graduate students expect from their graduate programs?
- How can we exploit the differences they bring to improve their graduate experience?

Completion Data:

"Big Picture" Findings have Policy Implications

- Nationally, Ph.D. completion probably *higher* than commonly thought (approx. 57% *vs. 50%*), *but field differences create policy challenges*
- Some underrepresented groups are taking *longer* to complete than before, but not necessarily completing at lower rates
- *Overall differences* in minority/majority completion rates are observable, but *field differences* in minority/majority completion rates are pronounced

Differences in Minority and Majority PhD Completion

	Under-represented Minorities 7-yr | 10-yr	Asian American 7-yr | 10-yr	Majority (White) 7-yr | 10-yr	Difference between URM & Majority (White) 7-yr | 10-yr
Engineering	46.4% | 58.7 %	45.7% | 53.6%	52.3% | 62.5%	**-5.9% | -3.8%**
Life Sciences	43.4 % | 63.2%	45.2% | 55.9%	54.3% | 63.8%	**-10.9% | -0.6%**
Physical Sciences & Mathematics	40.1% | 47.6%	41.8% | 52.3%	47.9% | 54.3%	**-7.9% | -6.7%**
Social Sciences	31.2% | 48.6%	35.4% | 48.5%	41.1% | 55.4%	**-9.9% | -6.8%**
Humanities	32.4% | 52.7%	33.1% | 55.4%	35.9% | 55.3%	**-3.5% | -2.6%**

Source: Council of Graduate Schools, Ph.D Completion Project Data

Completion Rates and Timing by Race/Ethnicity and Broad Field

	Under-represented Minorities (Domestic)									
	Native American		Black/African American		Hispanic		Asian American		Majority (White)	
Cohort	*7-yr*	*10-yr*	*7-yr*	*10-yr*	*7-yr*	*10-yr*	*7-yr*	*10-yr*	*7-yr*	*10-yr*
Engineering	69.2%	66.7%	**38.1%**	50.0%	**52.2%**	67.5%	**45.7%**	53.6%	52.3%	62.5%
Life Sciences	63.6%	100.0%	**41.4%**	59.5%	**42.7%**	63.0%	**45.2%**	55.9%	54.3%	63.8%
Physical Sciences/Math	54.6%	66.7%	**36.4%**	41.0%	**45.6%**	58.1%	**41.8%**	52.3%	48.0%	54.3%
Social Sciences	29.6%	20.0%	**33.6%**	50.7%	**28.2%**	48.2%	**35.4%**	48.5%	41.1%	55.4%
Humanities	29.2%	71.4%	**34.7%**	53.7%	**28.1%**	46.5%	**33.1%**	55.4%	35.9%	55.3%

Source: Council of Graduate Schools, Ph.D Completion Project Data

Department-Level Data Collection and Use

Chris M. Golde

Stanford University

Findings

- Integration into intellectual community
- Mentoring and advising
- Information flows and feedback

Integration into intellectual community

- Advance information
- Orientation
- Peer mentors
- Initial advising
- Shared courses
- Shared office space

Mentoring and advising

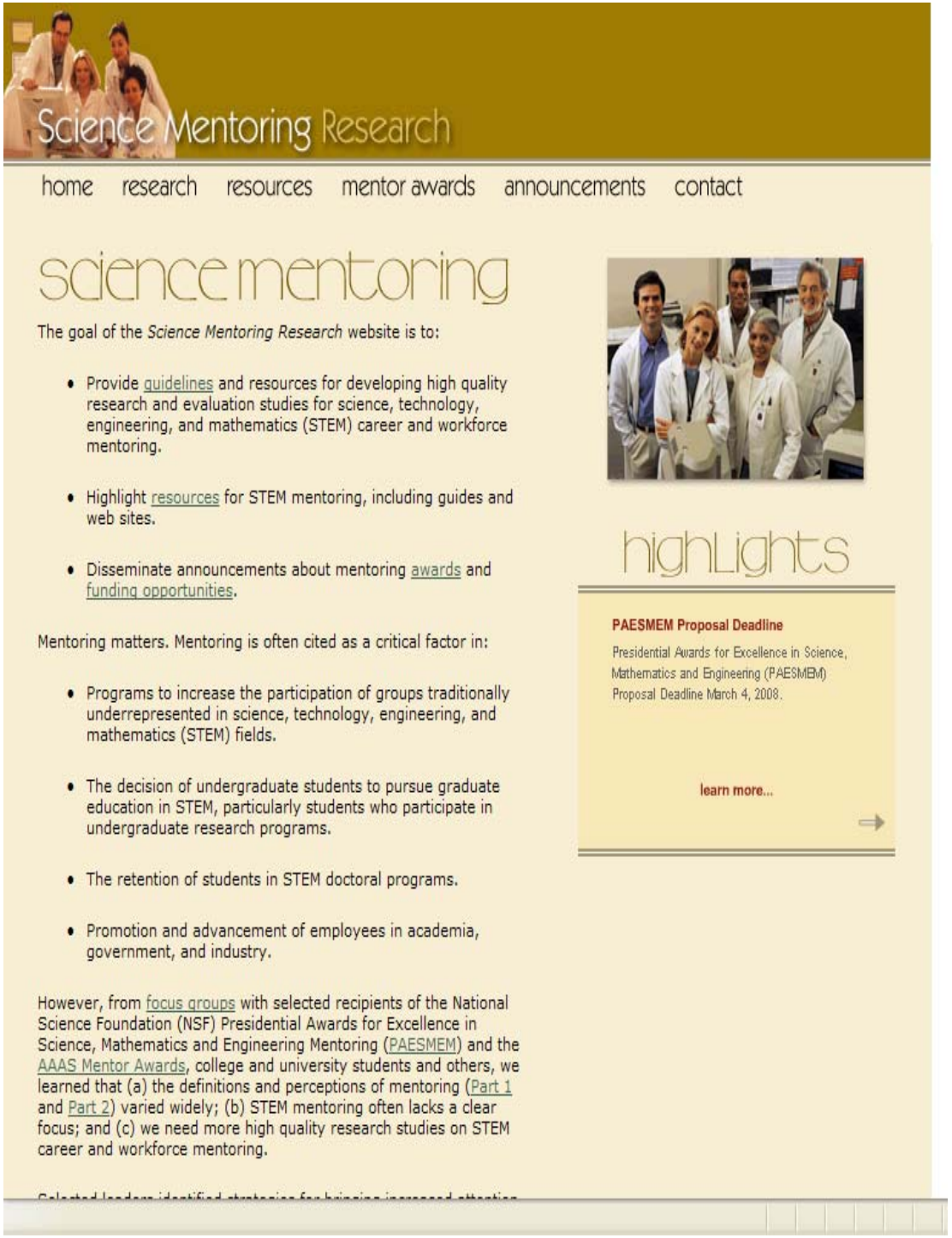
- Frequency of communication
- Multiple mentors
- Annual reviews
- Safety nets

Information flows and feedback

- How is graduate school different from undergraduate
- Clear expectations for & access to experiences
- Career paths of alumni

Questions to ask from data

- Does the department have a vibrant intellectual community?
- How are new students (postdocs, faculty) integrated into the departmental community?
- Does the department have a shared definition of “a successful student”? Are these expectations clearly conveyed to students?
- What career paths do program graduates follow? Are students gaining the experiences to be successful in their chosen career paths?



What Students Should Know

- **Abstracts/posters**
- **Oral presentations**
- **Literature reviews**
- **Formulate research questions.**
- **Statistical/computational skills**
- **Prepare/review papers.**

What Students Should Understand

- **The patent process**
- **Intellectual property**
- **Ethics.**
- **Best practices in teaching.**
- **Setting up/managing a lab**
- **Grant-writing**
- **Science policy**

In summary, the fundamentals of mentoring should be about retention to the PhD and STEM workforce preparation

- Academic preparation & support programs, particularly during the early course-taking years
- Making sure students are on track towards to the PhD, including nurturing during prep for qualifying and comprehensive exams.
- Early detection of switchers and leavers by departments
- Social and intellectual integration into the department
- Faculty mentoring that focuses on research productivity, career counseling, and workforce prep
- Attention to financial aid and debt burden
- Attention to family/work balance