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Many Factors, One Goal:
Observations from Current STEM Research

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Project Background

- STEM Trends In Enrollment & Persistence for Underrepresented Populations (STEP-UP)
- Funded by the National Science Foundation
- Examines factors that impact the entrance into, persistence in, and degree attainment in the STEM fields at large, public, research universities
  - By gender
  - By race/ethnicity
  - By socioeconomic status
  - By STEM field

Presentations

- Ife Onyenekwu – *Faculty Involvement in STEM Intervention Programs*

- Derek A. Houston – *Academic Engagement of Undergraduate Students in STEM*

- Erica Harwell – *Parent Occupation and Student Choice of STEM Major*

- Mariana G. Martinez – *Latinos/as in STEM: Navigational, Cultural, and Social Capital*

STEM Intervention Programs at Large Public Research Universities: Faculty Involvement

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Literature Review

- Role of faculty
- Large Universities
- Faculty Involvement Critical
- Positive Outcomes

Methodology

- Qualitative Study

- Interviewed administrators and directors in STEM intervention programs at large research universities

- Year 1: 55 participants; Year 3: 51 participants (20 new and 31 returning)

- Drew questions from literature that spoke to faculty involvement

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Faculty Involvement

- Can you describe the ways in which faculty participate in the program?

- Can you describe the type and level of support of the program from the faculty members?

- What are the current forms of collaboration with other units and/or faculty members on campus that the program benefits from?

Preliminary Analysis

Three themes emerged:

  a) Faculty Involvement
  b) Faculty As A Resource
  c) Lack of Faculty Involvement

Findings

Faculty Involvement

- Curriculum writing
- Mentoring
- Interviewing students

Administrator

"...we'll take it to the faculty and say here are our top three candidates you tell us who you're interested in. Sometimes they will have the student come in and talk to them, but we don't. Professor [name] and I, we kind of do the whole here's who we want you to look at, we can't interview 80 or 90 students times the 140 applications or so we have."

Faculty As A Resource

Several administrators discussed how professors helped write grants to fund programming:

"I am participating as a part of those co PIs, so I have faculty members that are writing those grants. I am helping write those grants, and being a co PIs in terms of the undergraduate students, of graduates students, community college students and high school students into these programs. So, that has made a tremendous difference."

Lack of Involvement

Conversely, some administrators complained about faculty who were not involved. These responses are strikingly different from the previous cases. The following responses express how administrators discuss faculty members that either do not have time or do not buy into the purpose of the programs.

"We even tried to get professors to do it, but they are busy."

Lack of Involvement

"I think with most programs like this predominantly white campuses majority of people don't necessarily see the benefits of the program. Especially when programs like this are usually directed and headed by people of color. I think they question the role of those who work in the program and whether or not what is happening and how things are facilitated are actually beneficial to students and beneficial to the college in general. So yea, I have never heard anyone kind of praising the program or talking about the program with students. So this has been interesting for me. So I feel like, hmmmm. I just don't know how it is really received. And I don't know if it is a program that is really respected or really supported by faculty and staff at large."

Discussion/Implications

- Finding adequate ways to involve faculty in programs in light of their professoriate responsibilities remains a key issue

- Faculty might be relatively uninformed

- There are less incentives for professors specifically at research universities

Recommendations

- Make mission and purpose clear
- Make this a priority for new faculty
- Have faculty members involved from the beginning
- Update and connect faculty to student services

Academic Engagement of Undergraduate Students Majoring in STEM

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Purpose of Study

- Investigate levels of academic engagement of undergraduate students by type of major (STEM vs. non-STEM)

- Investigate differences in engagement by gender and race/ethnicity

- Create a baseline from which to study how engagement might change over time

Review of Literature

- Engagement occurs when "students take advantage of the range of learning opportunities their institutions provide outside the classroom" (Reason, Terenzini & Domingo, 2006, p. 155)

- Horstmanshof & Zimitat (2007) found that students oriented towards future goals, such as careers after college, resulted in "an increase in the level of students' engagement with their studies, and potentially, an increased likelihood that they would continue with their studies long-term" (p. 715).

Student Demographics (n=4,561)

Variables	N	%
Gender		
Male	1,854	40.60%
Female	2,669	58.50%
Prefer not to Answer	38	0.80%
Race and Ethnicity		
White, not Hispanic	3,320	72.80%
Asian or Pacific Islander	561	12.30%
Hispanic or Latino/a	197	4.30%
Black, not Hispanic	176	3.90%
Other Race/Ethnicity	154	3.40%
Prefer not to Answer	130	2.90%
Native American or Alaskan Native	23	0.50%
Major Category		
STEM	4,066	89.10%
Non-STEM	495	10.90%

Source: Project STEP-UP Survey, 2011.

Authors' Calculations.

Research Questions

- How are students engaged academically at their university?

- How does academic engagement differ by type of major? By gender? By race/ethnicity?

Data & Methods

- Two iterations of online student survey administered in 2010 & 2011
- Students classified by STEM & Non-STEM
- Majors included in STEM
  - Science & Engineering
  - Agricultural & Biological Sciences
  - Health & Psychology
- Descriptive statistics and cross-tabulations
- Statistical significance indicated by the following:
  - *** P < .001; ** P < .01; * P < .05

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Academic Engagement Index
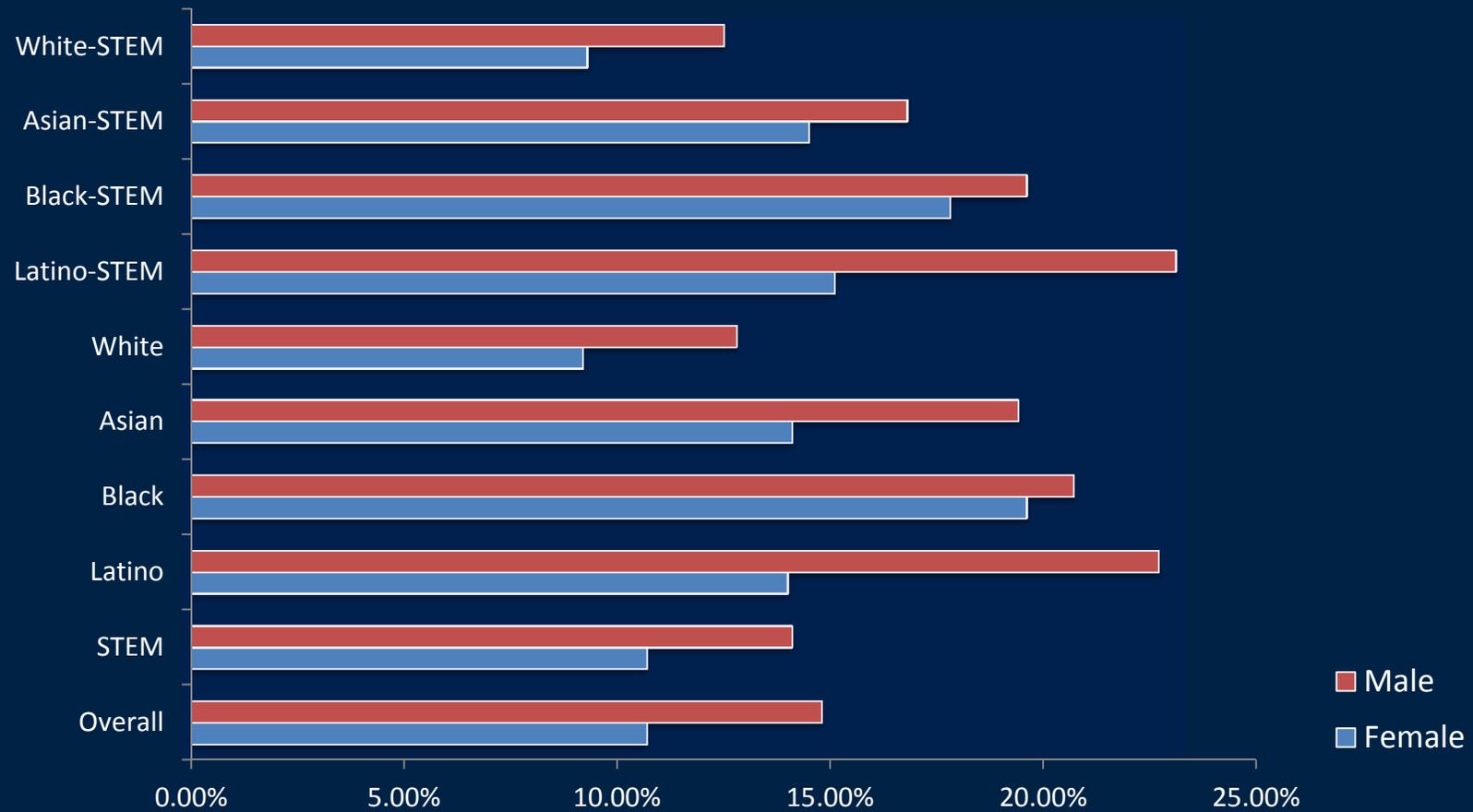## (Twice a Week or More)

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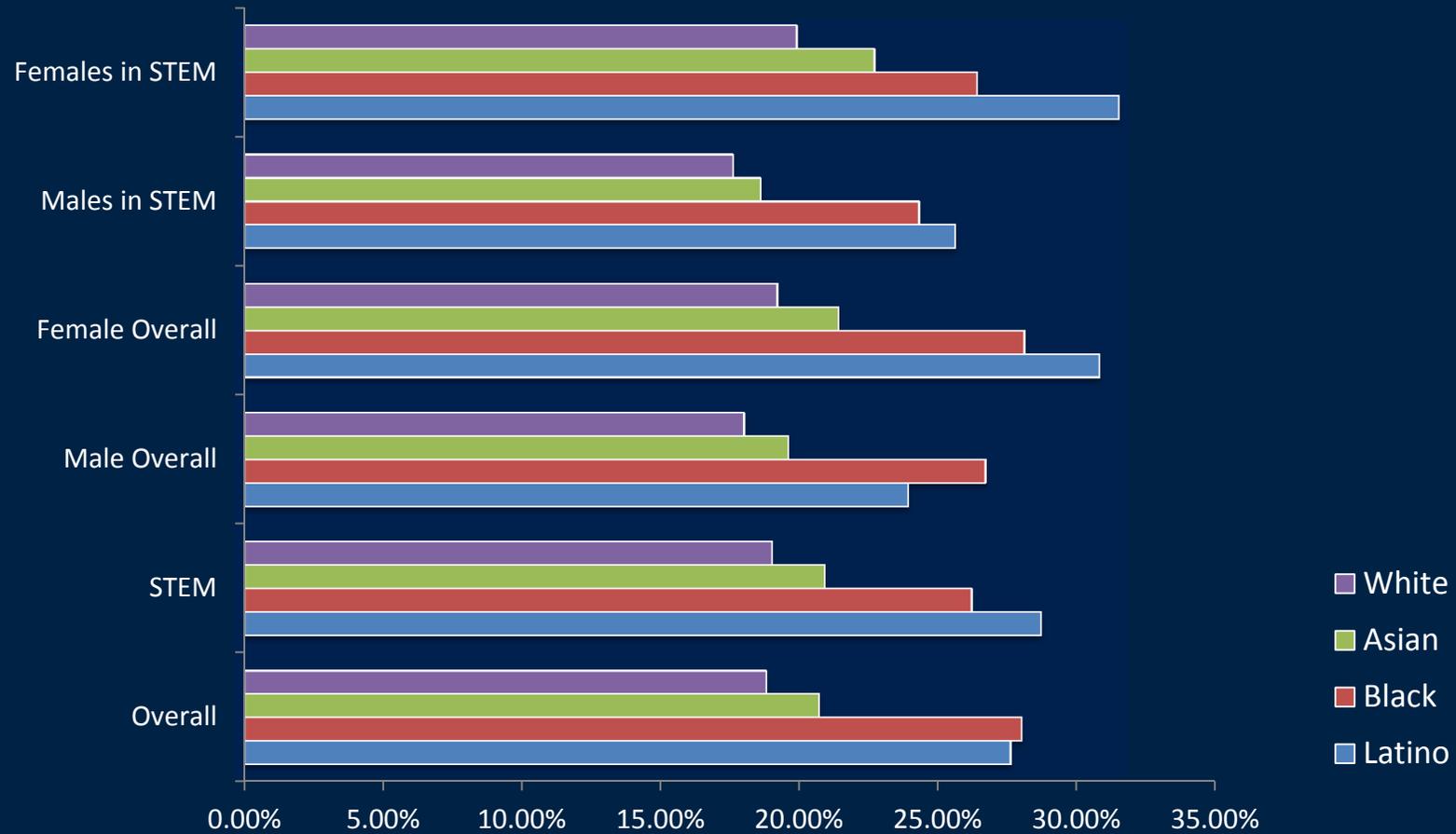
Working with Other Students Outside of Class

- 55% of STEM vs. 40.5% of Non-STEM (twice a week or more)***
- Males overall (twice a week or more)*
  - 72% Black; 58.6% Asian; 52.4% White; 48.9% Latino
- Males in STEM (twice a week or more)*
  - 71.9% Black; 60.4% Asian; 53.2% White; 52.4% Latino
- Females overall (twice a week or more)*
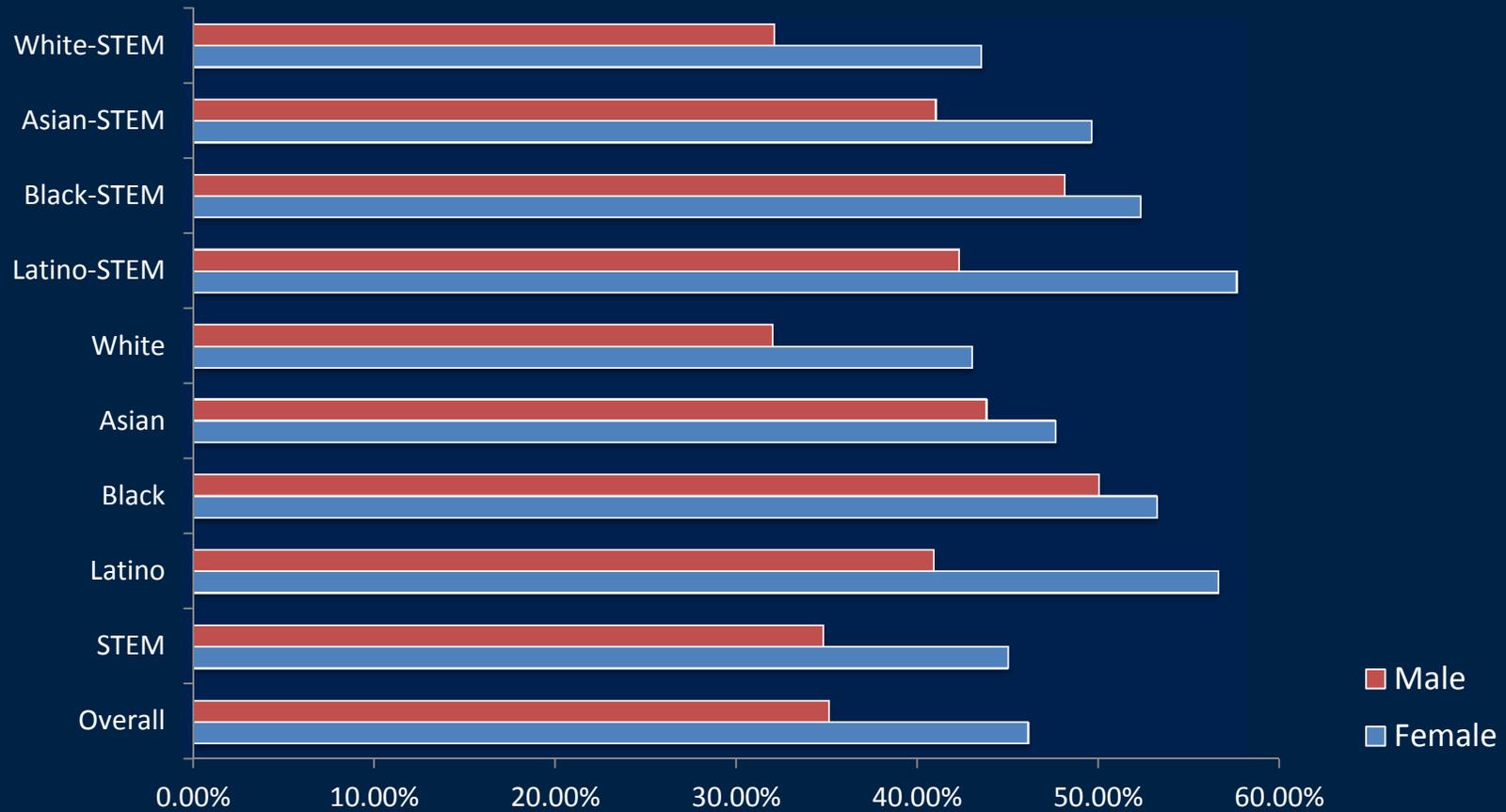 - 64.4% Latino; 57.0% Asian; 54.0% Black; 52.9% White

Discussing Ideas with Students within Major

- 49.5% of STEM vs. 44.0% of Non-STEM (twice a week or more)*
- Females overall (once a month or less)*
  - 29.6% Black; 20.0% Asian; 16.3% White; 15.4% Latino
- Females in STEM (once a month or less)
  - 26.4% Black; 17.9% Asian; 16.1% White; 14.6% Latino

Work Harder to Meet Teacher Expectations
(Twice a Week or More)

Limitations

- Small sample size of racial and ethnic minority students

- Variance of responses across each campus

- Survey noted to be long and many students did not complete the survey

- Generalizability of students and universities

Findings and Implications

- Positives
  - Both women and underrepresented students of color in STEM have high levels of academic engagement

- Negatives
  - Women show less engagement with professors, especially in STEM
  - Women and underrepresented students of color in STEM have to work harder to meet teacher expectations

- Implications
  - Inform recommendations for designing programs, services, or field-specific interventions to increase engagement levels for underrepresented students
  - Reinforce the need for culturally conscious programs and professors in STEM fields.

Future Research

- Examine relationship between academic engagement and persistence within STEM fields

- Examine differences of academic engagement by class standing (i.e. freshman vs. sophomore)

- Examine students' social and academic engagement as a measure of total engagement

Parent Occupation and Student Choice of STEM Major

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Purpose of Study/ Research Questions

- Parental occupation is one pre-college factor.

- Literature investigating parental factors that may influence a student's decision to select a certain major is limited .

- This study seeks to explore parent STEM occupations and student STEM majors, which are often the motivation for early familial-based STEM field recruitment attempts.

- Do differences in choice of STEM major exist among students with at least 1 parent in STEM?

- Do differences in choice of Engineering major exist among students with at least 1 parent in Engineering?

- Do students report parental influence of major decision differently by parent occupation?

Data & Methodology

- Data is from an online student survey conducted at 9 large, public research universities in 2010
  - 1881 total respondents
  - What was your father/male guardian's job title and in what industry did he work?
  - What was your mother/female guardian's job title and in what industry did she work?
  - Students were also asked who most influenced their current major selection, and chose from: Guidance Counselor, Parents, Peers, High School Teacher, Minister, Sibling, Family Friend, Other(please specify), I prefer not to answer
- Descriptive statistics and cross-tabulations were used

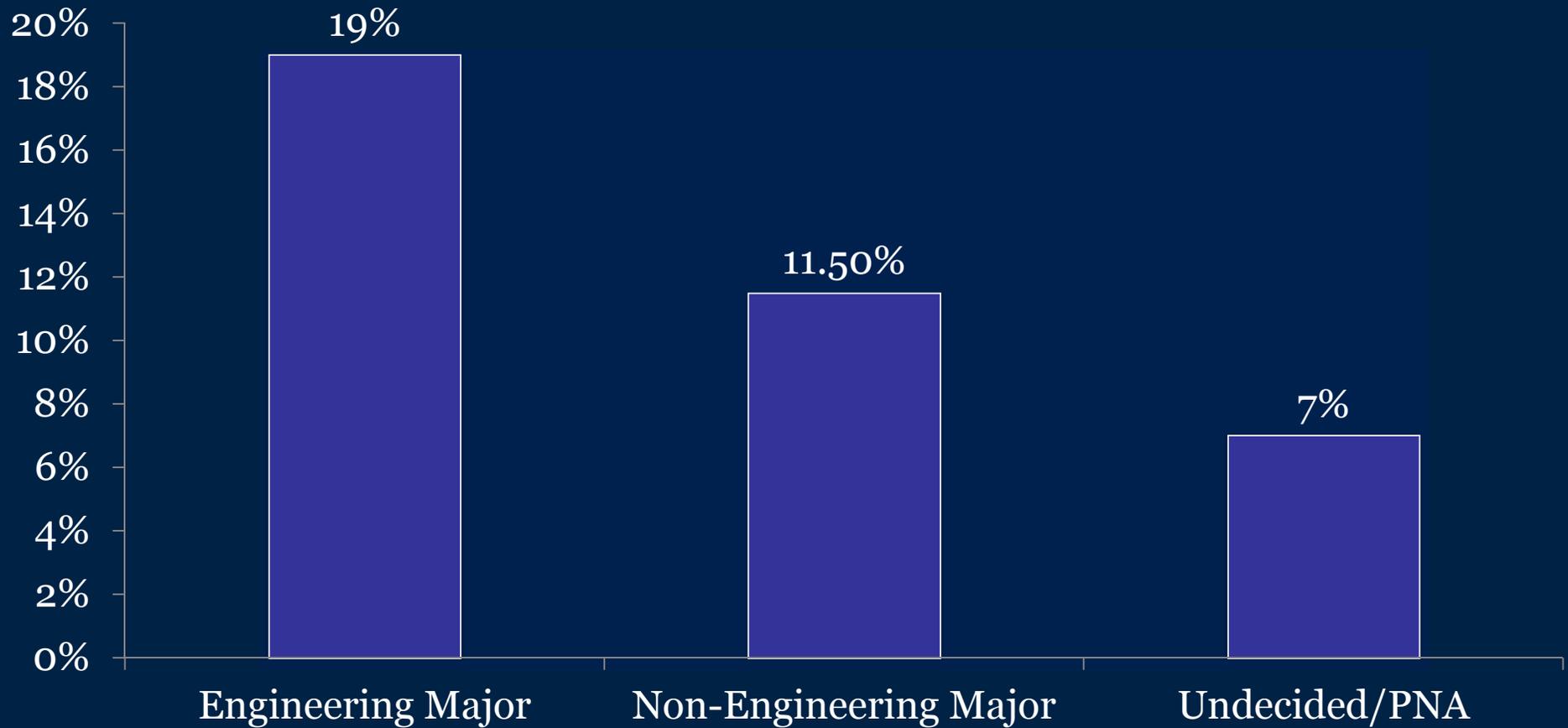| Variables	N	%
	Gender	
Female	1,151	61.20%
Male	716	38.10%
Prefer not to Answer	14	0.70%
	Race/Ethnicity	
White not Hispanic	1,361	72.40%
Asian or Pacific Islander	218	11.60%
Hispanic or Latino	89	4.70%
Black, not Hispanic	81	4.30%
other	69	3.70%
Prefer not to Answer	52	2.80%
Native American or Alaskan Native	11	0.60%
	STEM Major	
STEM	1,447	76.90%
Non-STEM	356	18.90%
Undecided or PNA	78	4.10%
	Engineering Major	
Yes	719	38.20%
No	1,084	57.60%
Undecided or PNA	78	4.10%
	Parent Occupation	
STEM	529	28.10%
Non-STEM	1,087	57.80%

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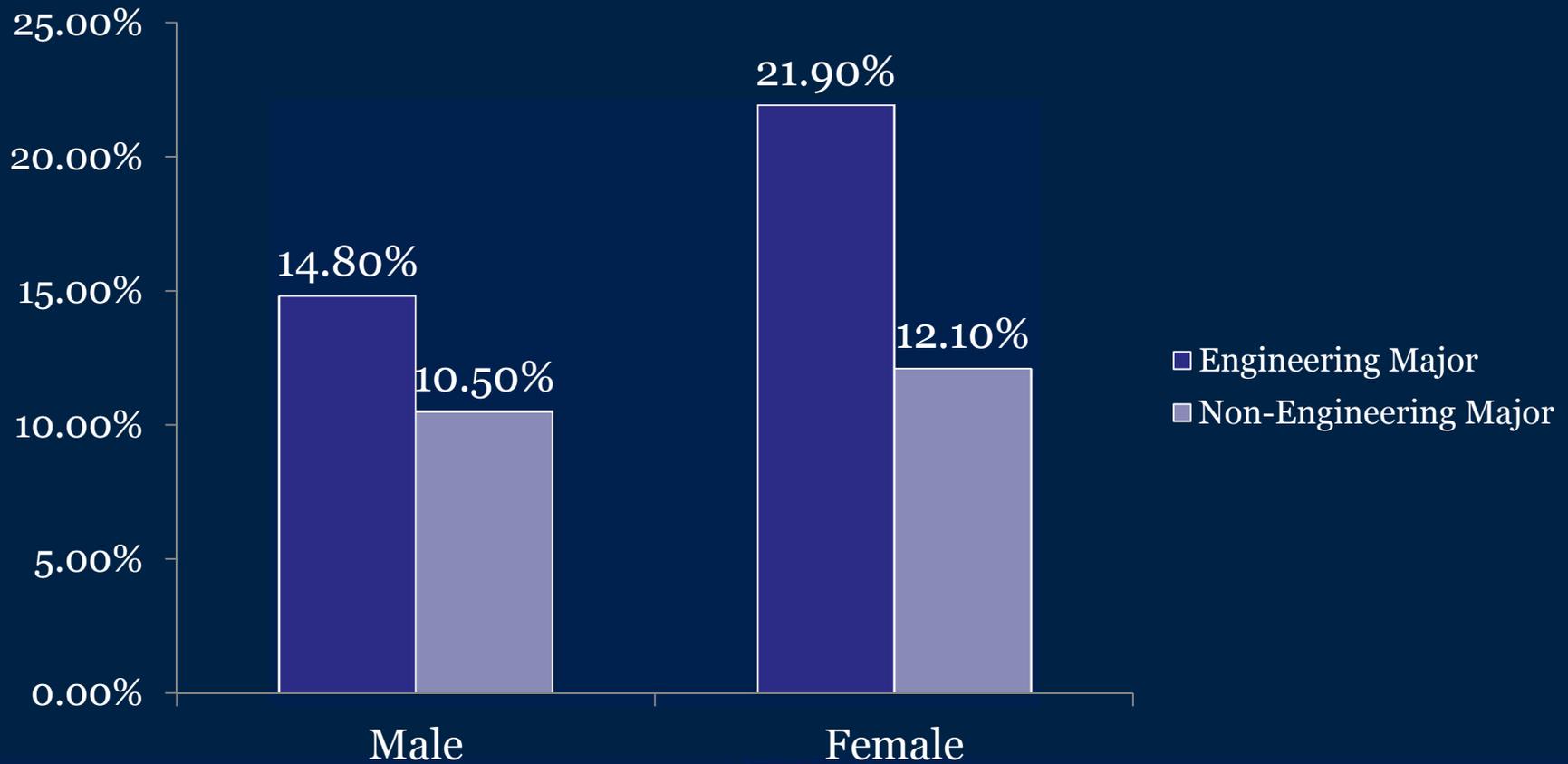
What is STEM?

- STEM MAJORS
  - "Hard" Sciences
  - Engineering
  - Math
  - Computer Programming
  - Health Sciences

- STEM OCCUPATIONS
  - Research related
  - Health professionals
  - Practicing Engineers
  - University faculty in STEM field
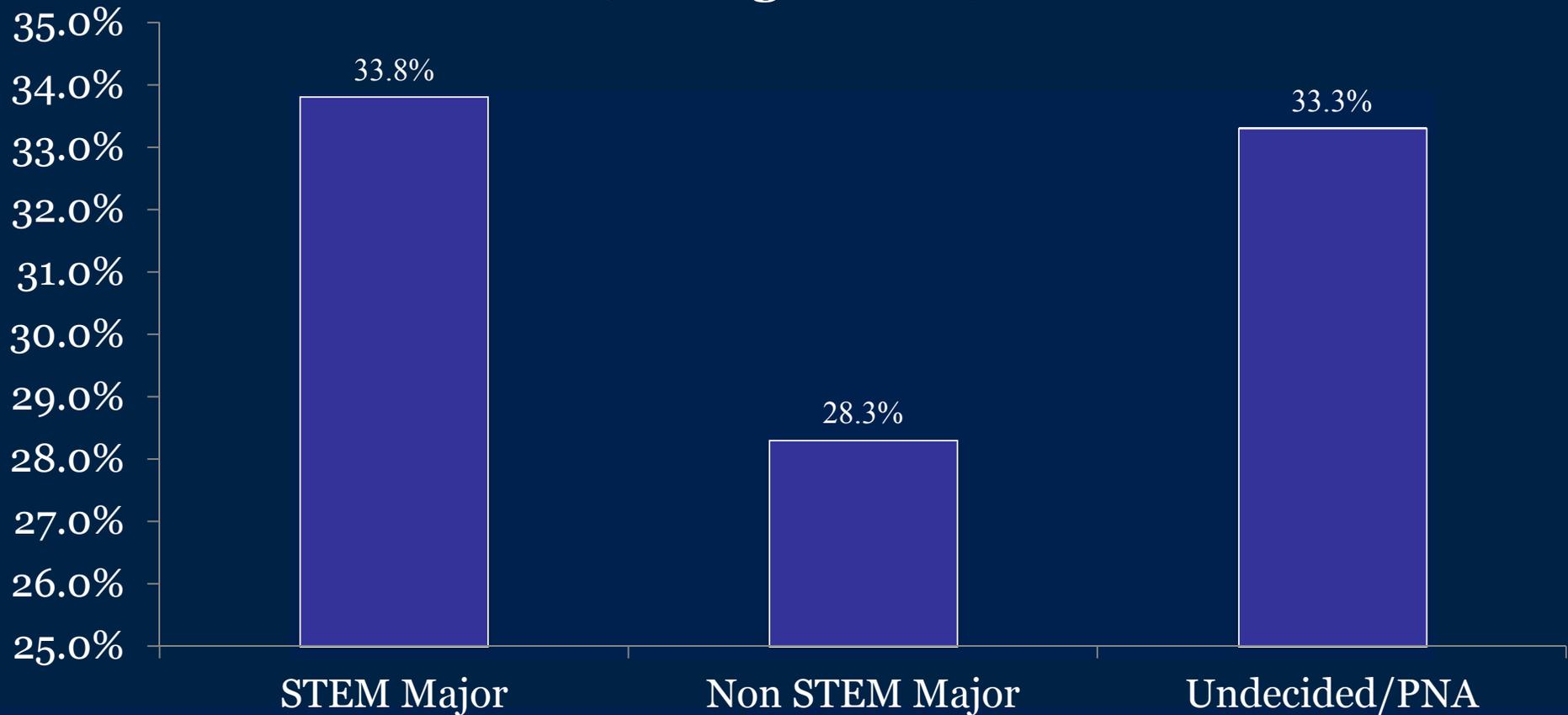 - Math/science based-professions (math teacher)

Percentage of respondents within major with at least 1 parent in STEM occupation (not significant)

Parents Influence on Major

- Engineering majors who cited parent as biggest influence of major
  - 69.7% had no parent in Engineering
- STEM majors who cited parent as biggest influence of major
  - 54.3% had no parents in STEM

Discussion/Implication of Results

- Non-significant results of STEM majors
  - Student's major does not necessarily lead to specific career
  - There may be new trends in the current generation's major decisions and parent occupation connections
  - Student's perception of occupation may matter more than what the parent actually does; not all student/parent relationships are equal
- Significance of Engineering as found in other literature
  - STEM may be too broad
- Parental influences
  - Does parent occupation determine if/how parent influences student's major?

Limitations

- What is STEM? Different definitions lead to different empirical results
- Pros and cons of survey with open-ended questions
- Survey had high number of respondents who were STEM majors
- Not a diverse enough sample to investigate race/ethnicity differences
- Students from major research universities

Future Research

- Further exploration of definition of STEM Major and STEM Occupation
- Investigate additional pre-college factors such as student high school of attendance
- Additional 2011 survey data

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Latina/o Students in STEM:
An Examination of Navigational and Social Capital

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Purpose of Study

- Explore the use of Yosso's (2005) community cultural capital framework
    - navigational
    - social

- Examines Latina/o undergraduate experiences within STEM.

- This perspective on capital sheds light to the valuable, but often cited as "deficit", culture of minority communities.

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Research Questions

- How does community cultural wealth help us understand the Latina/o student experience within the STEM fields?

  – How does social and navigational capital play a role in student's undergraduate STEM experience?

Latina/os in the United States

- Over 14.5 percent of the U.S. population
- 25% of US population by 2050
- Represent more than 23% of kindergartners in private and public schools
- Only 19 percent of Latinas/os ages 25 years and up had earned a postsecondary degree
- Most undereducated population in the U.S.

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Latina/os in Higher Education

- Latinos will be 22 percent of the nation's college-age population by 2020
- In 2009, only 12.7 percent were college graduates
- College enrollment for 2009 was of 29.1 percent
- Latino adults, 25 years and over, were also less likely to have earned an associate degree or higher than other adults

Latina/os in STEM Education

- In 2001, Latino students earned 7.2 per cent of all bachelor's degrees and 4.7 per cent of all master's degrees in math and science

- In 2006, Latinos made up 2 % of STEM-workforce

Why so few??

- Students Face many obstacles
  – Curriculum, structural, and cultural interventions
  – Dropped-out/ pushed-out of high school at an alarming rates and are rarely exposed to curriculum that would spark interest in STEM professions

Latina/os in STEM: pre-college

- Disproportionately take less intensive classes
  - Less rigorous science and math curriculum
- Little access to more demanding classes even when they are offered
  - Assigned and/or placed in low curriculum tracks
- For ELLs, focus on English language acquisition and mastery takes away from core of math and science related concepts

Latina/os in STEM: college-level factors

- Large proportion of Latino students come from low-income households
- Have financial responsibility at home
- When they can balance both – work and school, takes them longer to graduate = cost more ($$)
- Rise in tuition cost + higher STEM related tuition
- First generation status
- Lack of good pre-college preparation

Conceptual Framework

- Community wealth capital:
  - Incorporates Critical Race Theory
  - 'non-traditional' forms of capital – rooted in ethnic-centered community resources –

- Sources:
  - aspirational capital, familial capital, navigational capital, resistant capital, and social capital

Data & Methodology

- Data is from an online student survey conducted at 9 large, public research universities in 2010
  - 1881 total respondents
  - Survey instrument includes questions regarding students'
    - *socio-demographic backgrounds*
    - *academic preparation and experiences*
    - *social activities*
    - *financial aid*
    - *notions of self-efficacy and engagement*

Data & Methodology Cont'd.

- Focus was placed on social and navigational capital

- Questions included (Likert-scale):
  - Family support has been instrumental to my success
  - Family has encouraged me to stay in college
  - Most of my friends expect me to do well in college
  - Knowledge and skills gained in my major will help others
  - What was your father/male guardian's job title and in what industry did he work?

- Descriptive statistics and cross-tabulations were used

Social Capital

- Social support
- Familial expectations of pursuing a higher education
- Importance of family support
- encouraging them to persist
- set a good example for their siblings or peers
- community

Navigational capital

- Involved in a STEM related high school program
- Surround themselves with friends who have high expectations for them
- Parent influential in choosing college, but credit themselves on choosing major
- In college, 60% participated in activities/events sponsored by an organization within their major
  - 68.4% service underrepresented populations
- Work and discuss with other students
- 62.6% participate in community service or volunteer efforts

Limitations

- Generalizations to the broader public are limited
- Limited to self-identifying Latina/o students
- Proxy of social and navigational capital

Questions & Discussion

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