

Gender & Racial-Ethnic Gaps Among Entering Science, Technology, Engineering and Mathematics (STEM) Majors

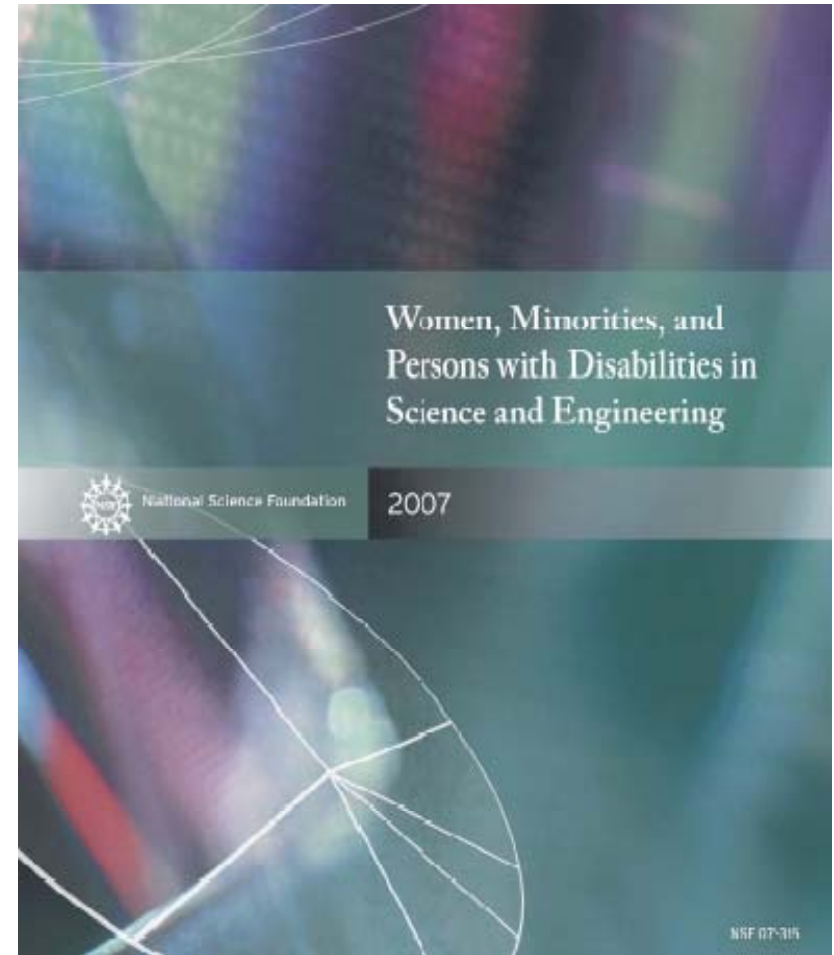
AIR Forum 2008, Seattle



**Jim Cole and Jillian Kinzie
Indiana University Center for Postsecondary
Research**

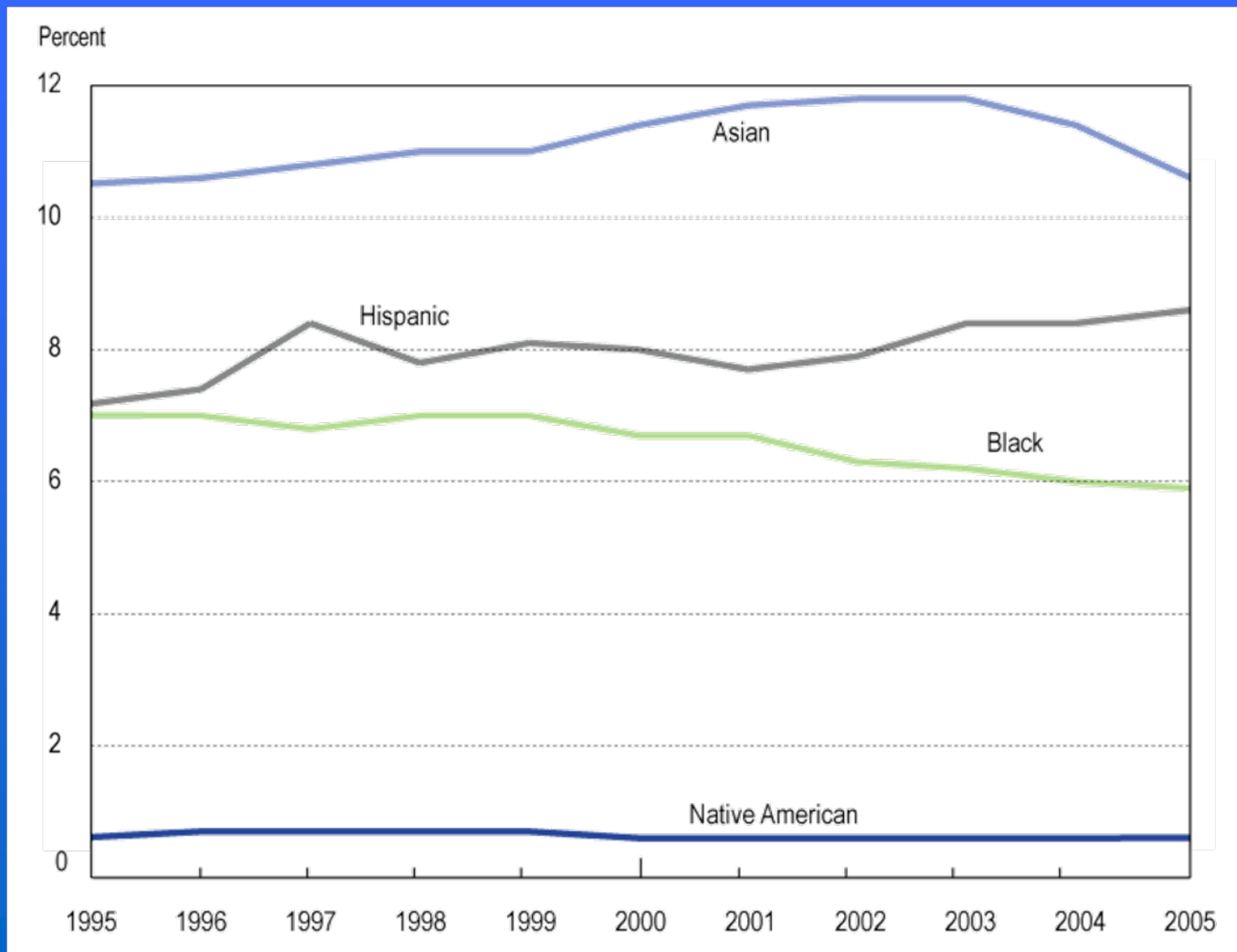
Current Context for STEM

- Global competitiveness
- Poor performance of US students in international measures of math achievement
- Persistent gender and racial-ethnic inequities in STEM field participation and degree completion



<http://www.nsf.gov/statistics/wmpd>

Minority undergraduate engineering students, by race/ethnicity: 1995–2005



SOURCE: *Women, Minorities and Persons With Disabilities in Science and Engineering (December 2006)*



TABLE B-8. Intentions of freshmen to major in S&E fields, by race/ethnicity and sex: 2004

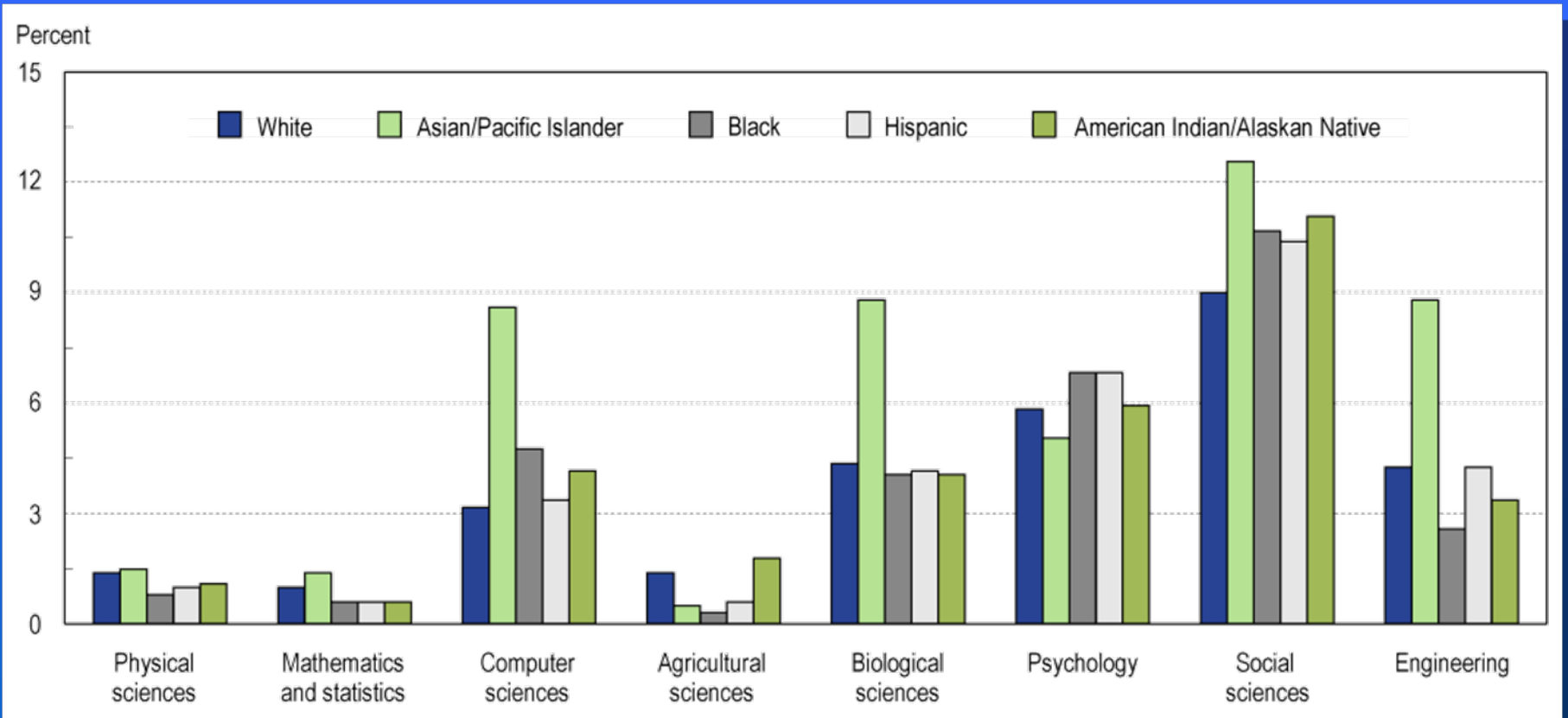
(Percent)

Race/ethnicity and sex	All S&E majors	Biological/ agricultural sciences	Computer sciences	Engineering	Mathematics/ statistics	Physical sciences	Social/ behavioral sciences
All races/ethnicities	33.1	8.3	2.0	9.6	0.7	2.3	10.2
Female	26.3	9.0	0.4	2.9	0.6	1.9	11.5
Male	40.8	7.4	4.1	17.9	1.0	2.9	7.5
White	30.1	7.0	1.9	9.0	0.8	2.3	9.1
Female	23.9	7.7	0.3	2.7	0.7	1.9	10.6
Male	38.7	6.4	3.9	17.0	1.0	3.0	7.4
Asian	45.5	16.1	2.2	15.1	0.9	2.4	8.8
Female	37.6	18.0	0.6	5.6	0.8	2.0	10.6
Male	54.3	14.1	4.1	25.8	1.0	2.6	6.7
Black	34.3	9.5	3.3	7.7	0.5	1.8	11.5
Female	31.9	10.9	1.5	2.9	0.4	1.9	14.3
Male	38.2	7.5	6.2	15.1	0.6	1.7	7.1
Hispanic of Mexican/Chicano/Puerto Rican descent	37.2	9.3	2.2	10.8	0.7	1.6	12.6
Female	31.7	10.4	0.6	3.1	0.7	1.3	15.6
Male	45.0	7.9	4.5	21.0	0.8	2.1	8.7
Other Hispanic	38.3	9.1	1.8	10.2	0.9	1.9	14.4
Female	33.8	10.4	0.7	3.4	0.7	1.6	17.0
Male	45.1	7.4	3.4	20.0	1.1	2.7	10.5
American Indian	33.8	8.6	2.2	7.8	0.6	2.5	12.1
Female	29.4	9.0	0.5	2.9	0.5	2.1	14.4
Male	40.7	8.2	4.7	15.2	0.7	3.2	8.7

NOTE: Includes first-year students at all 4-year colleges. Race/ethnicity categories are those used in the survey's data collection.

SOURCE: Higher Education Research Institute, University of California at Los Angeles, Survey of the American Freshman, special tabulations (Los Angeles, CA, 2005).

Bachelor's degrees awarded to racial/ethnic groups in S&E fields: 2004



SOURCE: *Women, Minorities and Persons With Disabilities in Science and Engineering (December 2006)*



Thinking about the Challenge...

- Women and minority students under-representation in STEM fields is a **complex challenge** for educational institutions.
- **Instructive** to better understand the high school experiences, including course-taking patterns and beliefs about preparation, more importantly, students' expectations for their investment in educationally purposeful activities in college, **so that educators can address gender and racial-ethnic differences and support student engagement in STEM fields.**

Research Questions

For those students entering their first-year of college intending to major in a STEM field:

1. Do the *family, social, and economic factors* of first generation status and level of financial assistance differ between gender and ethnicity?

Research Questions

For those students entering their first-year of college intending to major in a STEM field:

2. Do *individual factors* related with high school academic experiences (e.g., high school grades, SAT/ACT test scores, high school academic engagement, and hours per week preparing for class) differ between gender and ethnicity?

Research Questions

For those students entering their first-year of college intending to major in a STEM field:

3. Do *individual factors* related with their expected first-year experiences (e.g., expected academic engagement, academic preparation, expected grades, and expected hours per week preparing for class) differ between gender and ethnicity?

Data Source

Beginning College Survey of Student Engagement



Purpose of BCSSE:

- To measure entering first-year students' pre-college academic and co-curricular experiences.
- As well as their expectations and attitudes for participating in educationally purposeful activities during the first college year.

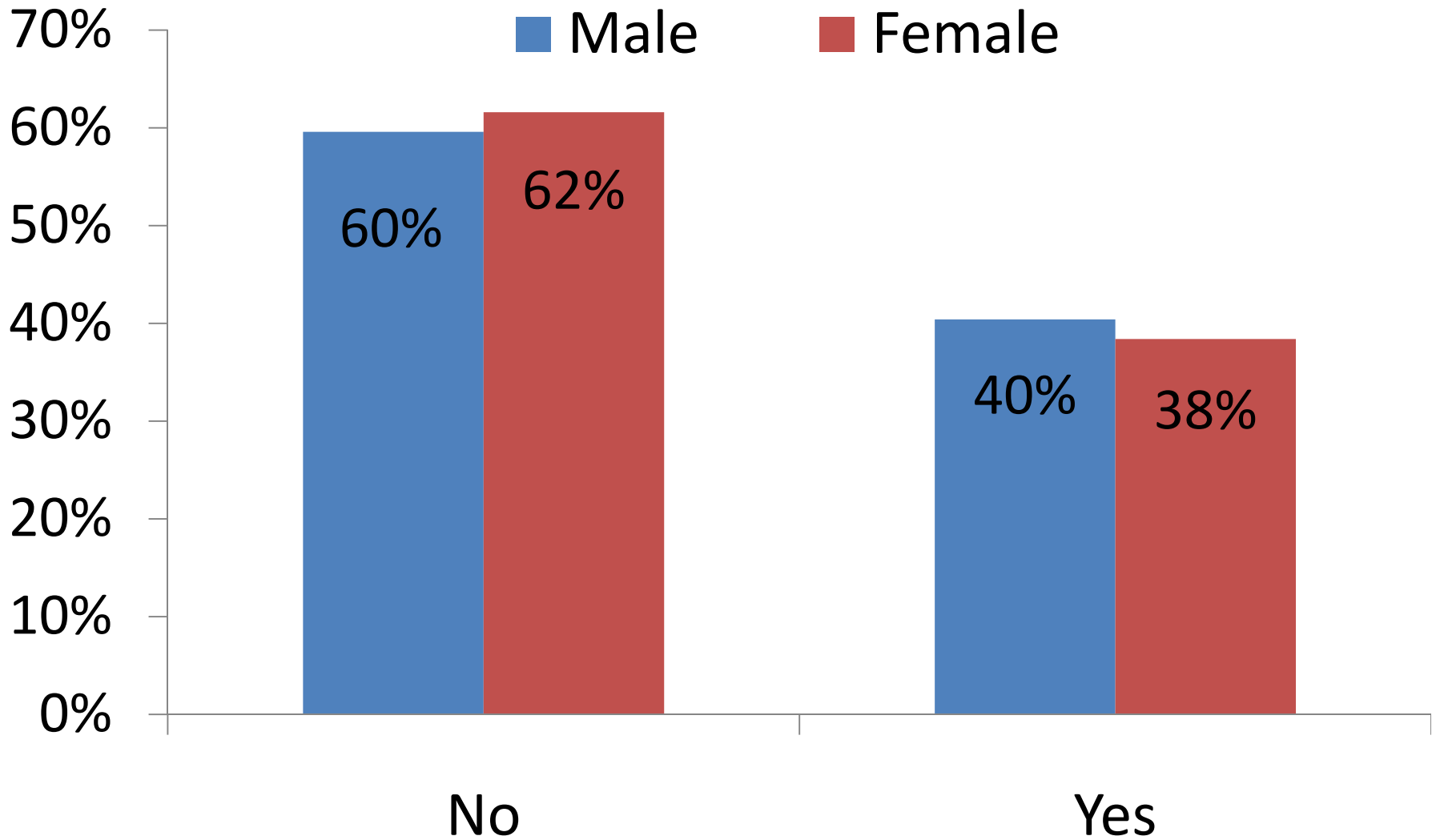
BCSSE Scales and Items

- *High School Academic Engagement* ($\alpha = .76$)
[7 a-c, 8a, 9 a-g; 9i-j]
- *Expected First-Year Engagement* ($\alpha = .72$)
[14a-k; 13a]
- *Academic Persistence* ($\alpha = .80$) [15a-f]
- *Expected Academic Difficulty* ($\alpha = .62$) [16abdf]
- *Academic Preparation* ($\alpha = .80$) [17a-g]
- *Importance of Campus Environment* ($\alpha = .81$) [18a-f]
- Items on BCSSE having to do with time on various tasks spent in high school and expected in college
[30, 19 a-d; gender, ethnicity, calculus 4b]

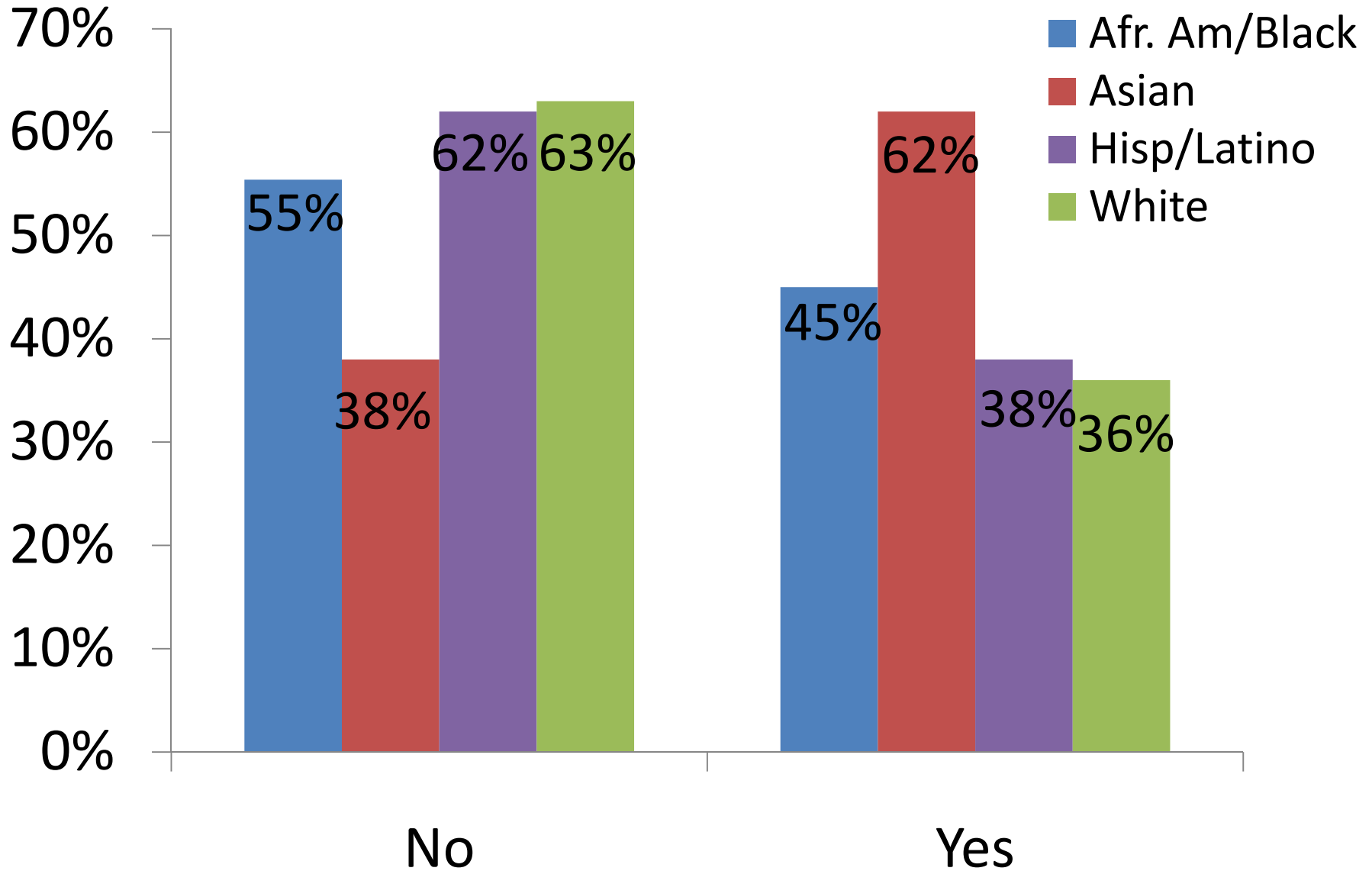
Sample Characteristics

- 9,754 first-year, full-time students majoring in STEM
- Enrolled at 81 institutions
- 59% female; 41% male
- 14% African American/Black; 9% Asian; 6% Hispanic/Latino; 71% White

Expecting to Major in a STEM Field



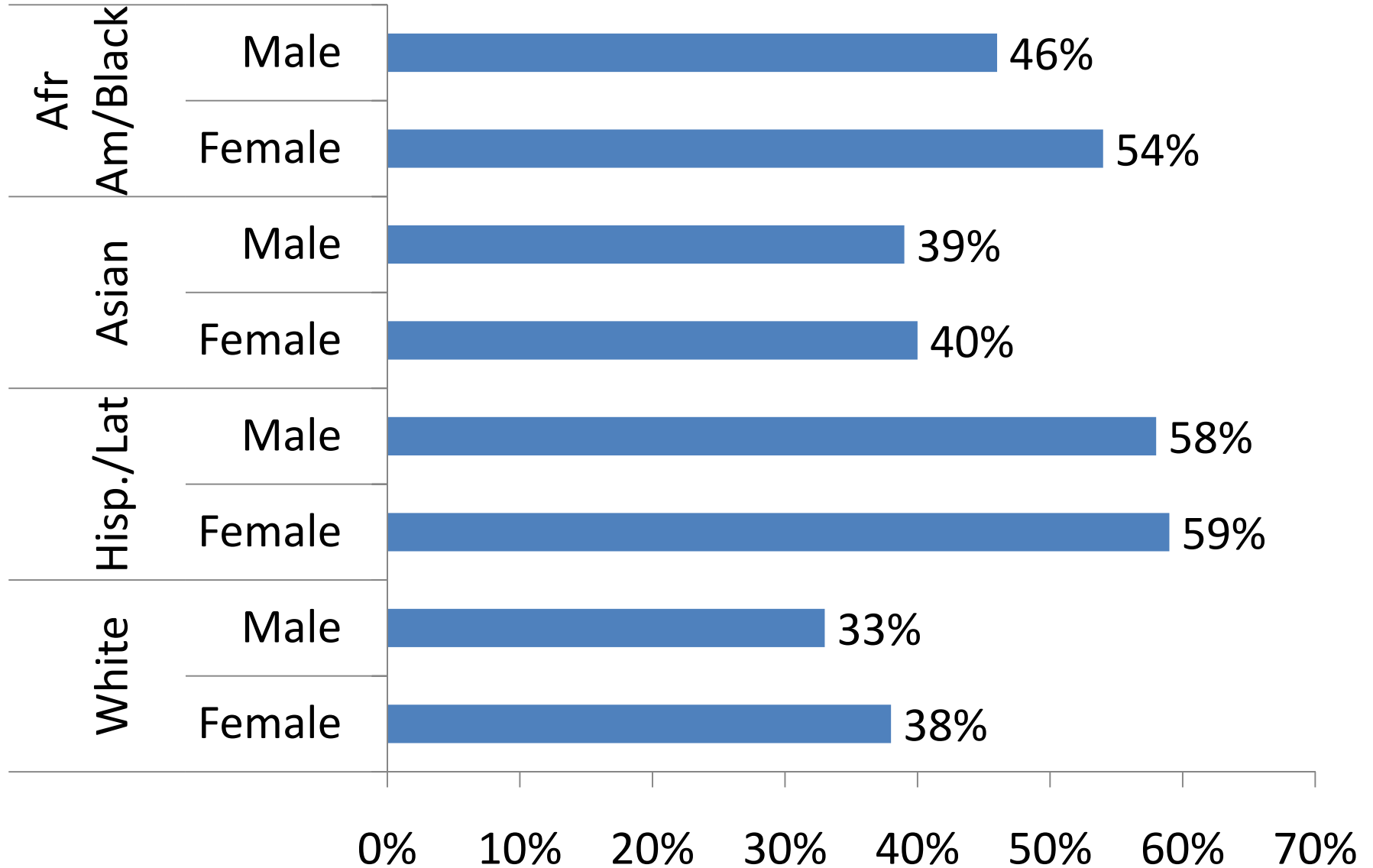
Expecting to Major in a STEM Field



Research Question 1

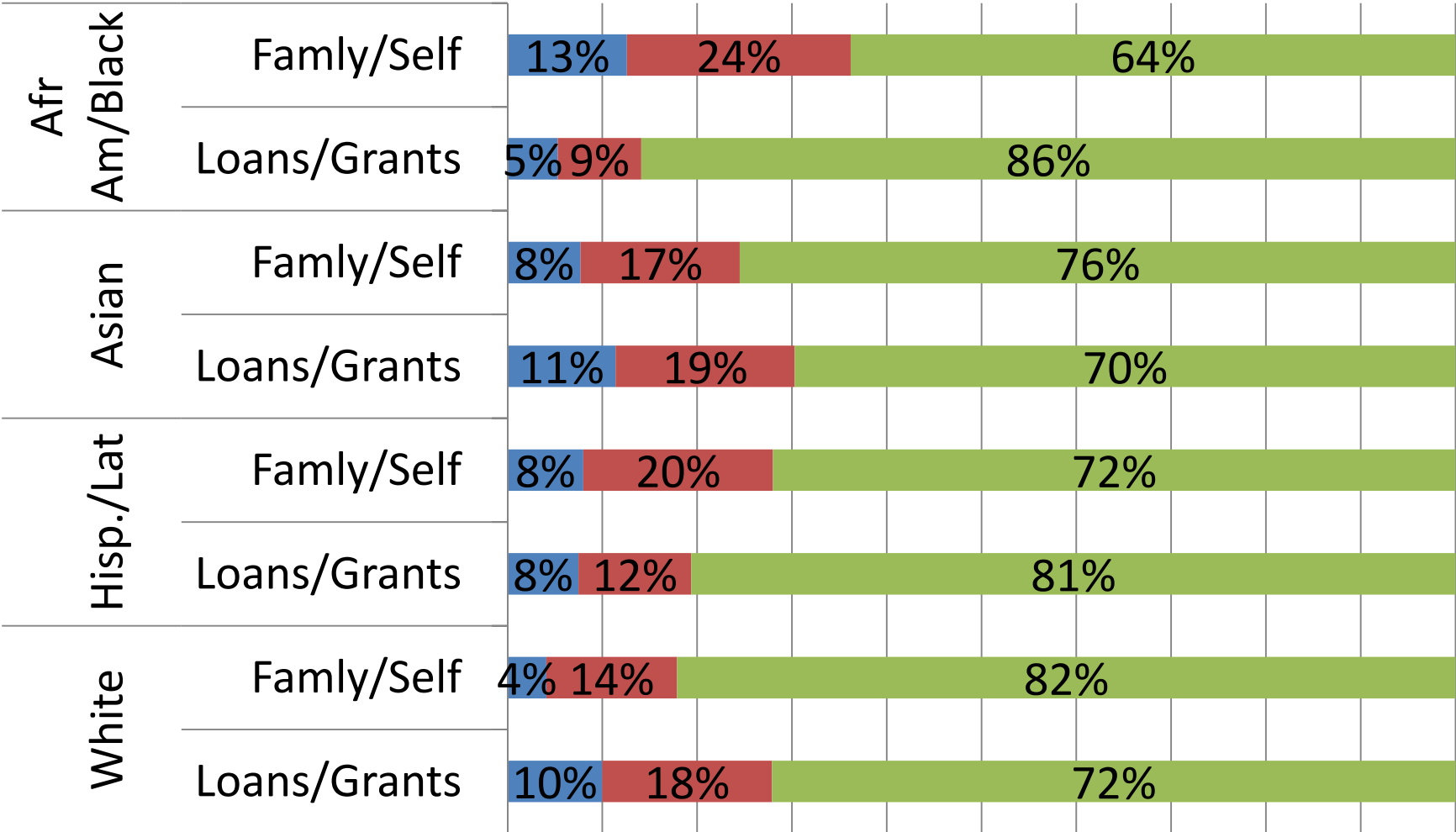
Do the family, social, and economic factors of first generation status and sources of financial assistance differ between gender and ethnicity?

First Generation Status: Gender & Ethnicity



Estimated Expenses Paid by Source

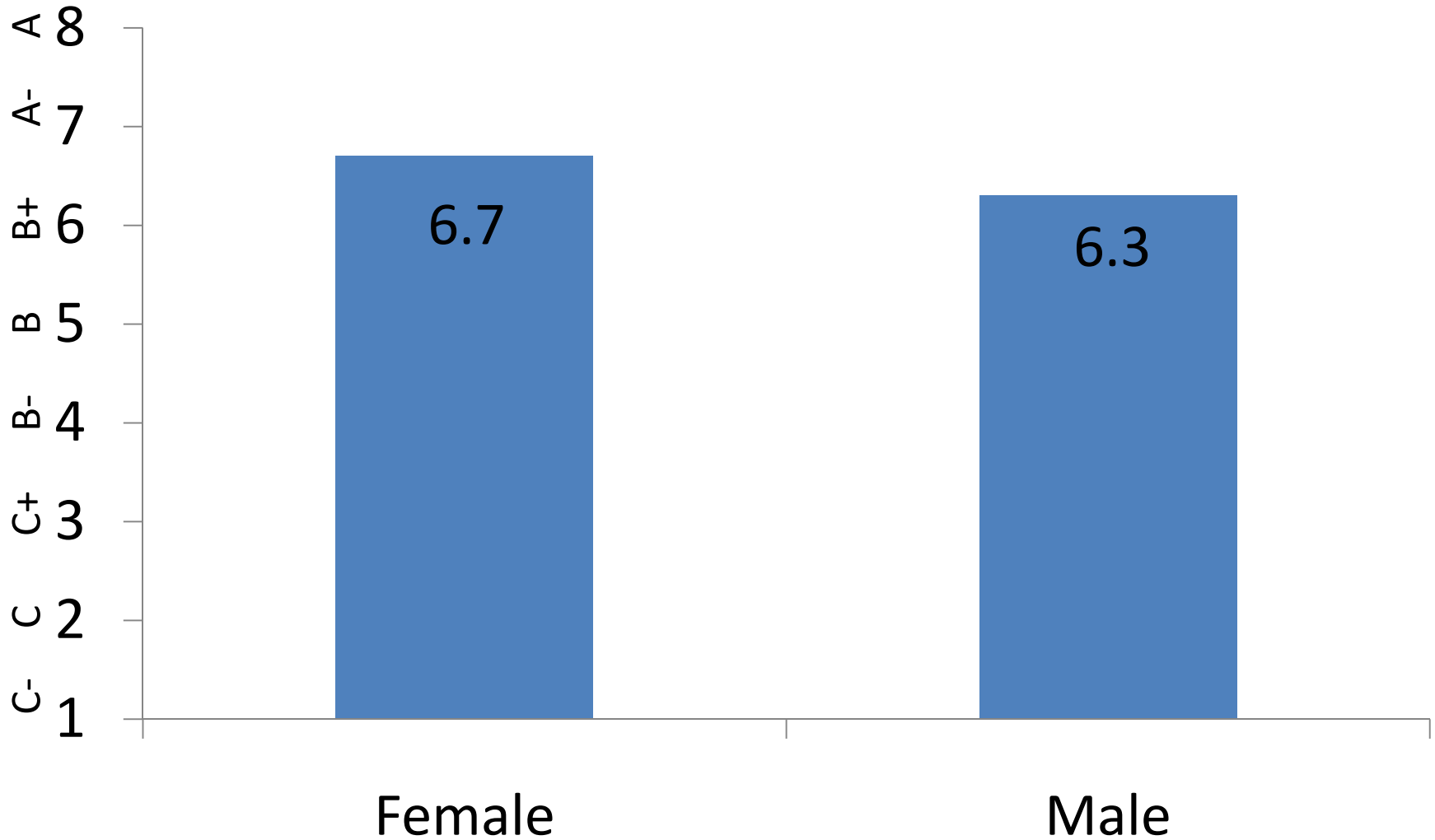
■ None ■ 25% ■ 50% or more



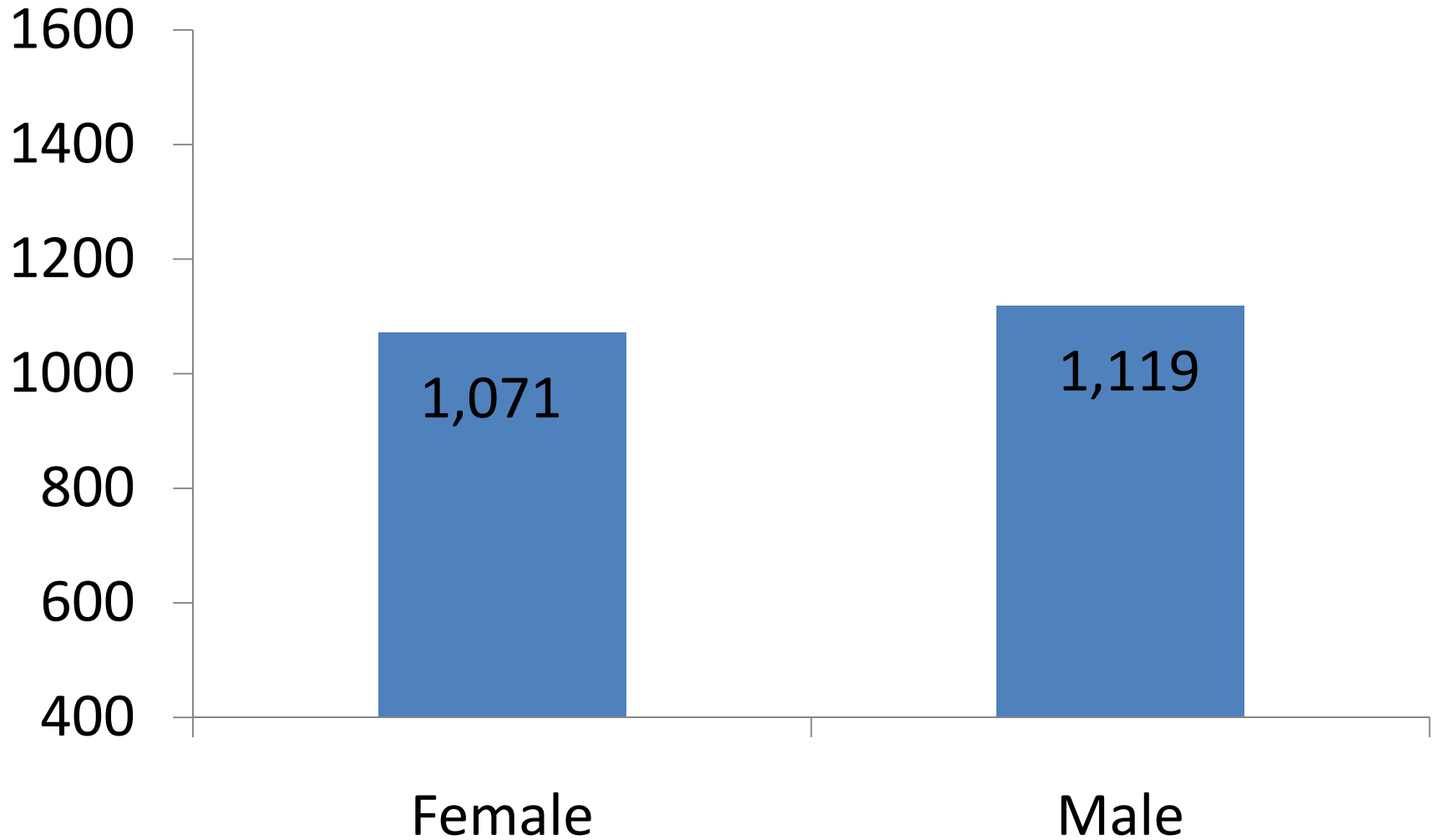
Research Question 2

Do individual factors related with high school academic experiences (high school grades, SAT/ACT test scores, high school academic engagement, and hours per week preparing for class, passing grade on high school calculus) differ between gender and ethnicity?

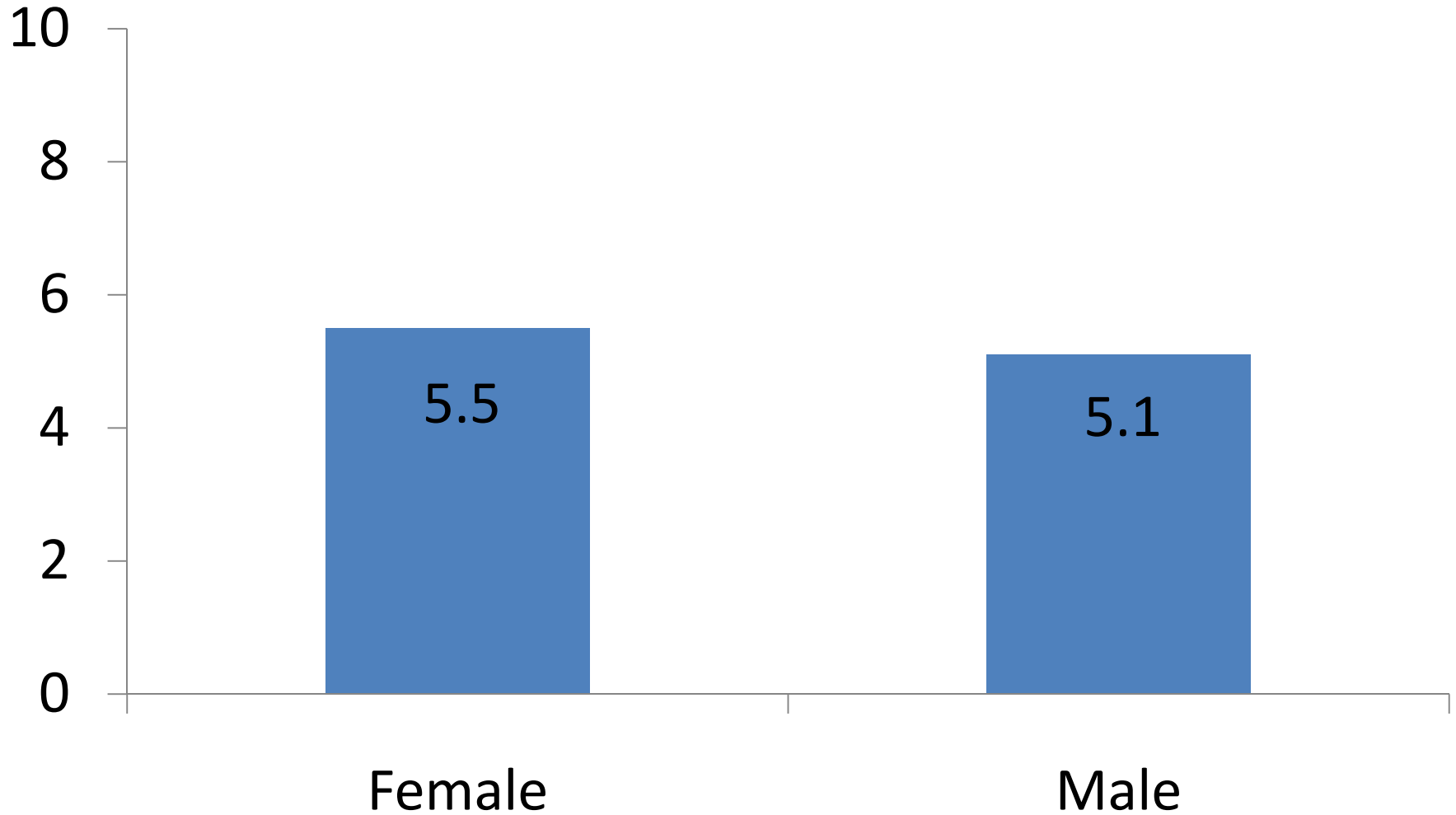
High School Grades by Gender



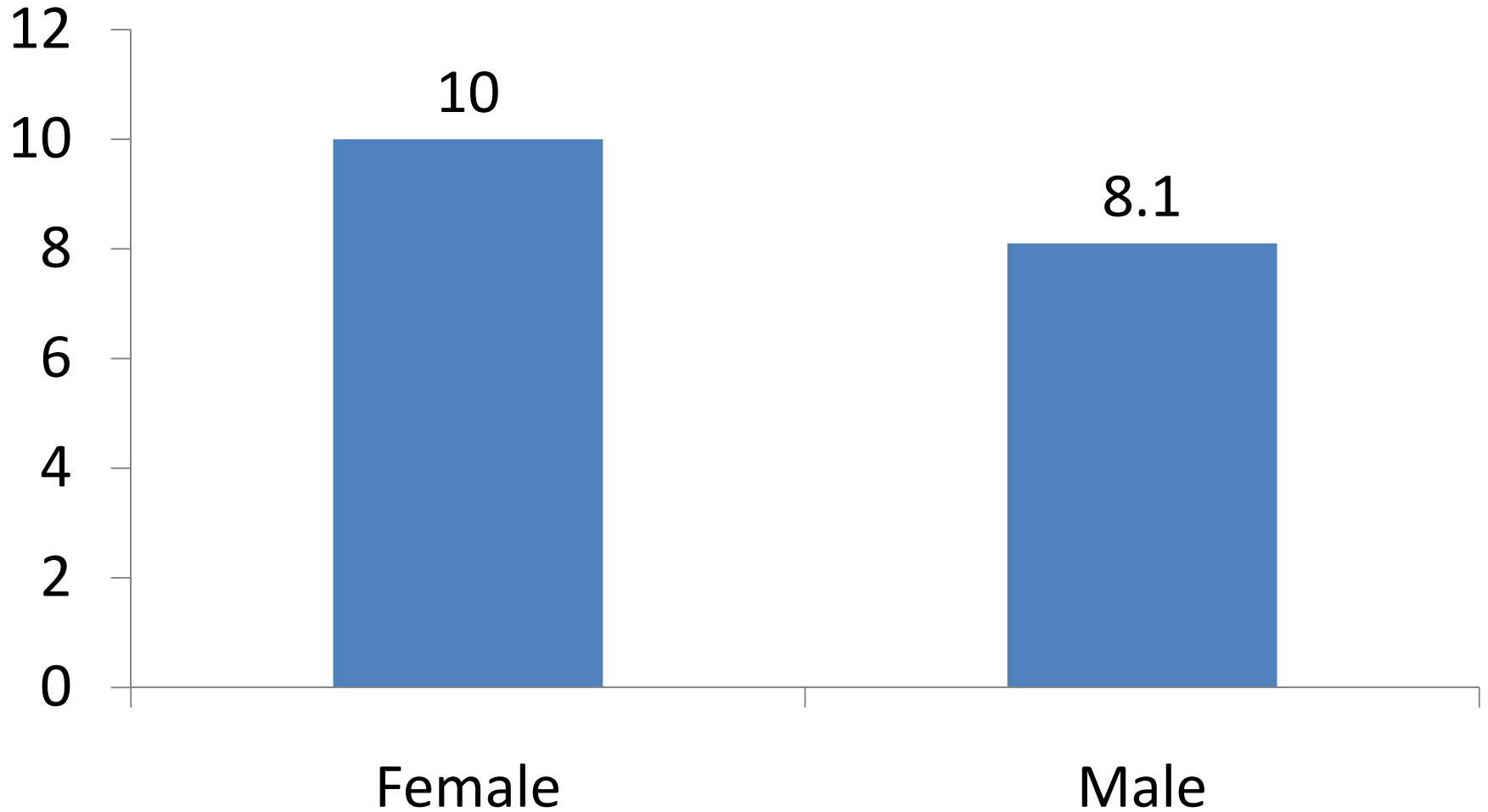
SAT/ACT Scores by Gender



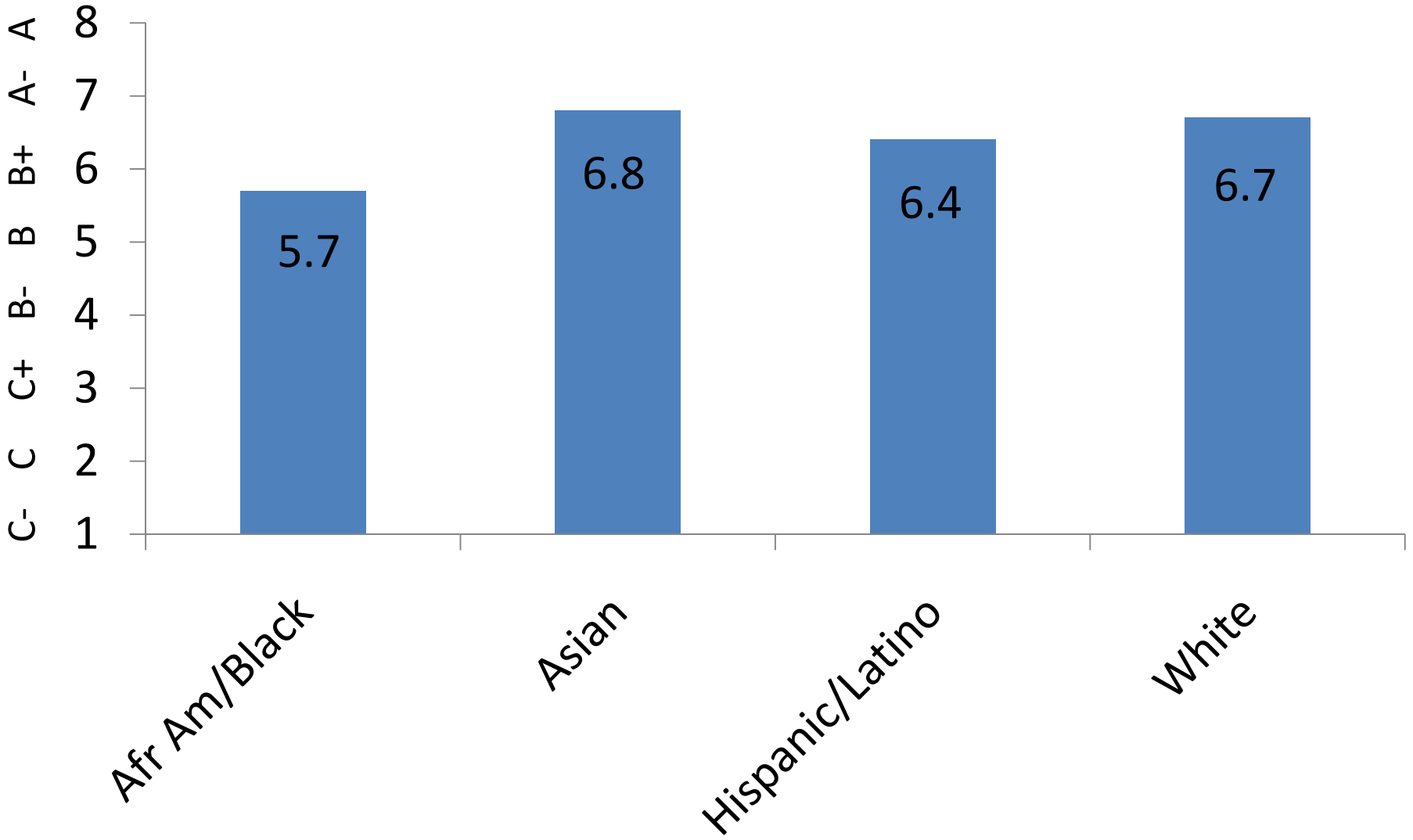
HS Academic Engagement by Gender



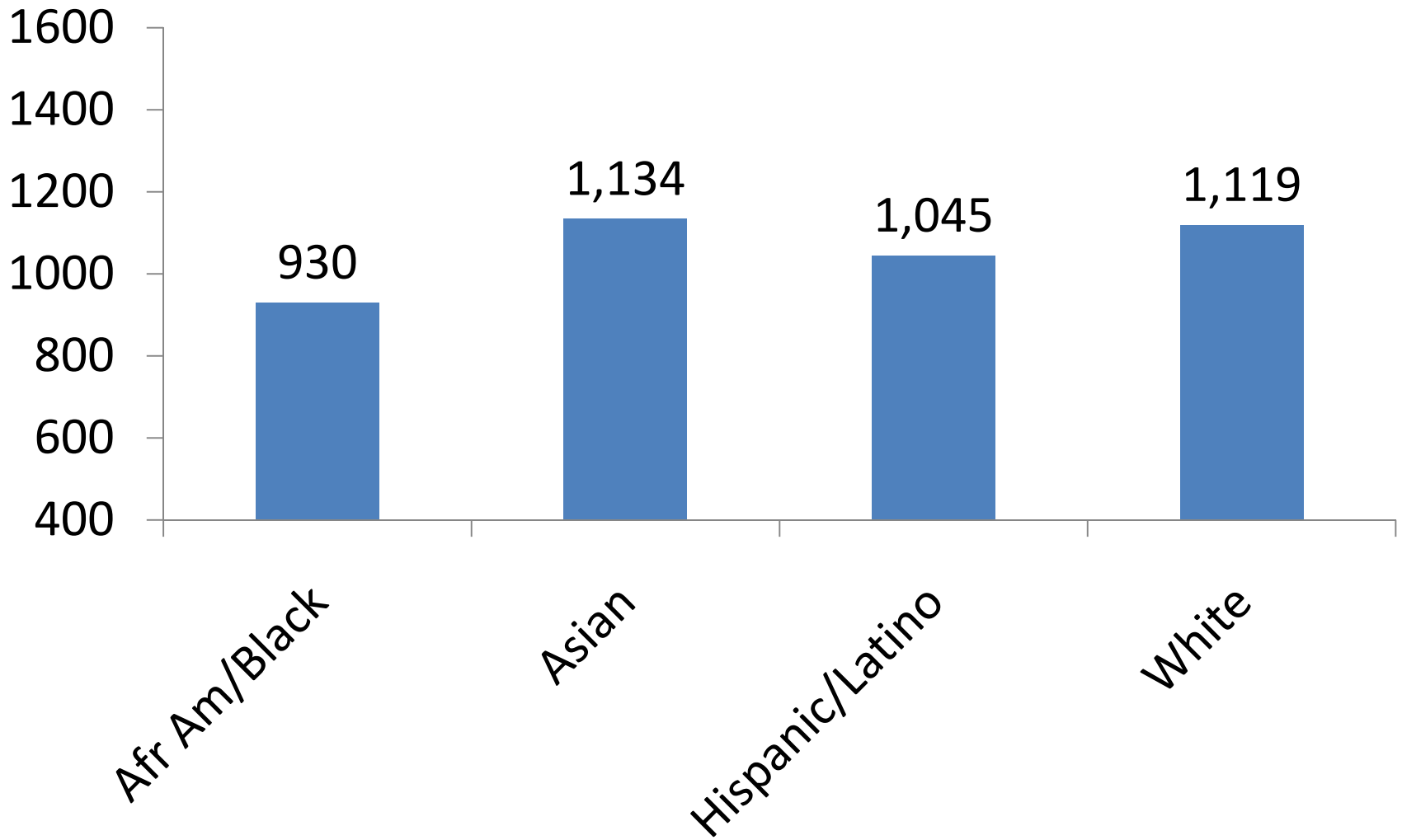
Hours per week in HS Studying by Gender



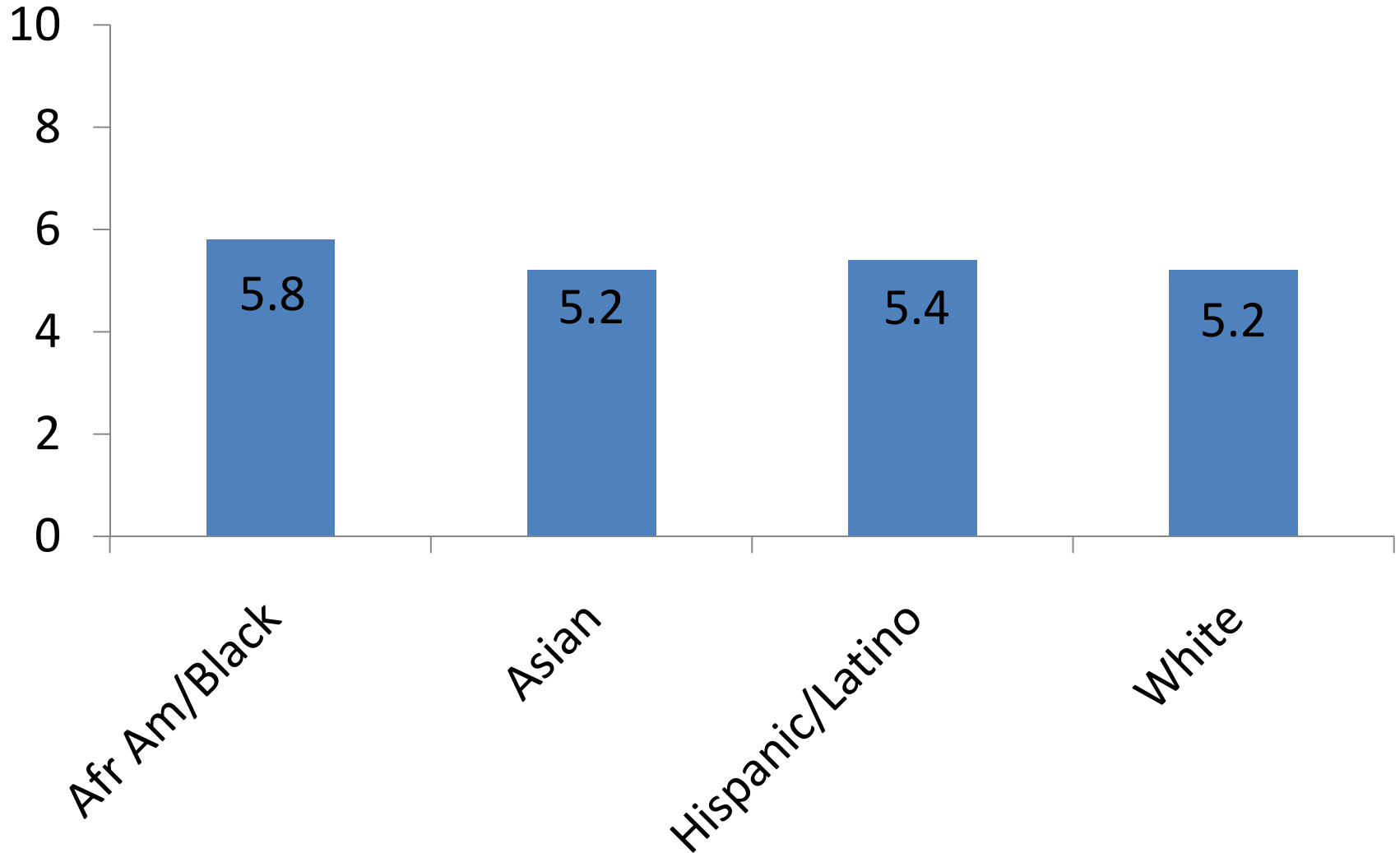
High School Grades by Ethnicity



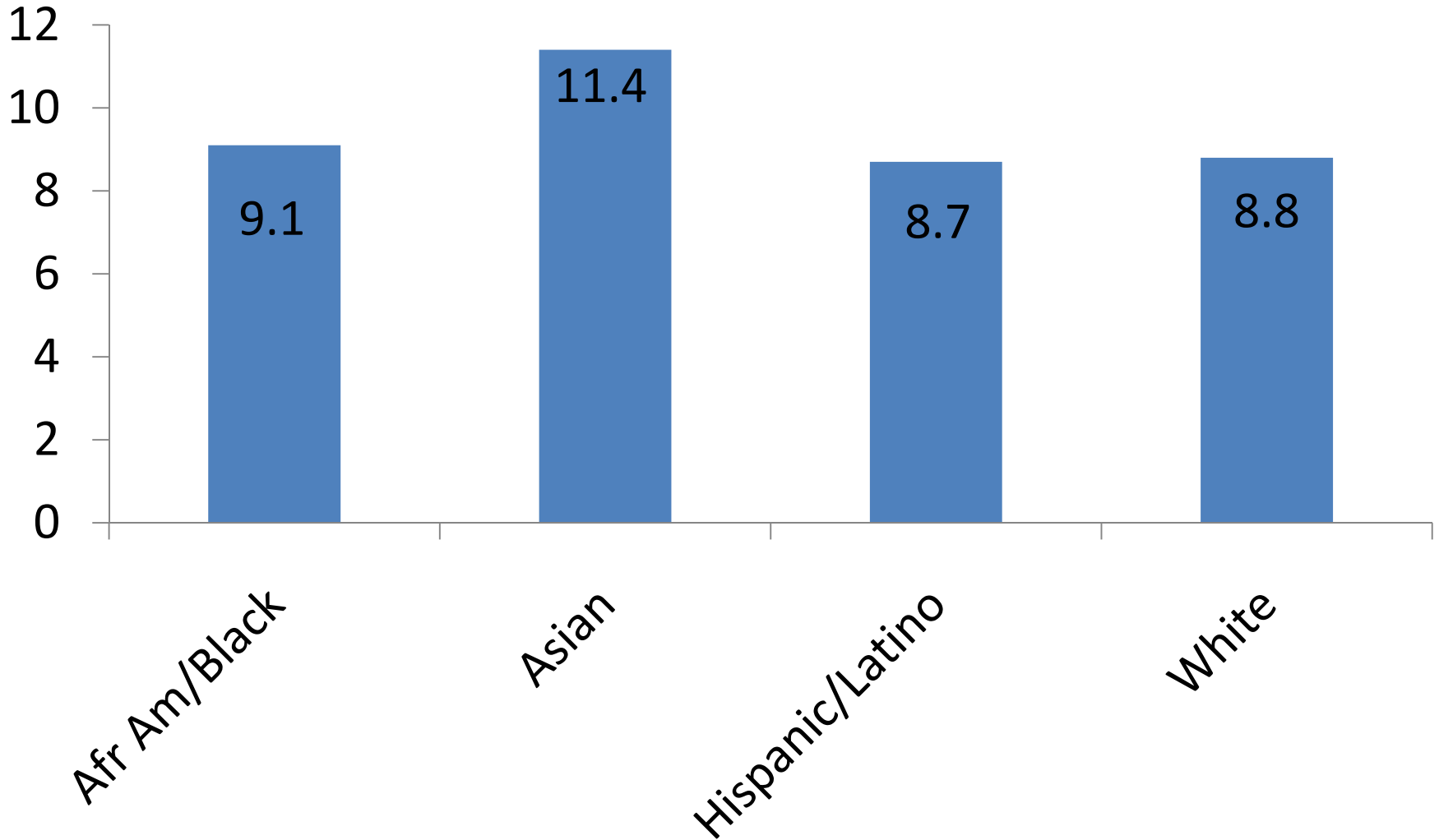
SAT/ACT Scores by Ethnicity



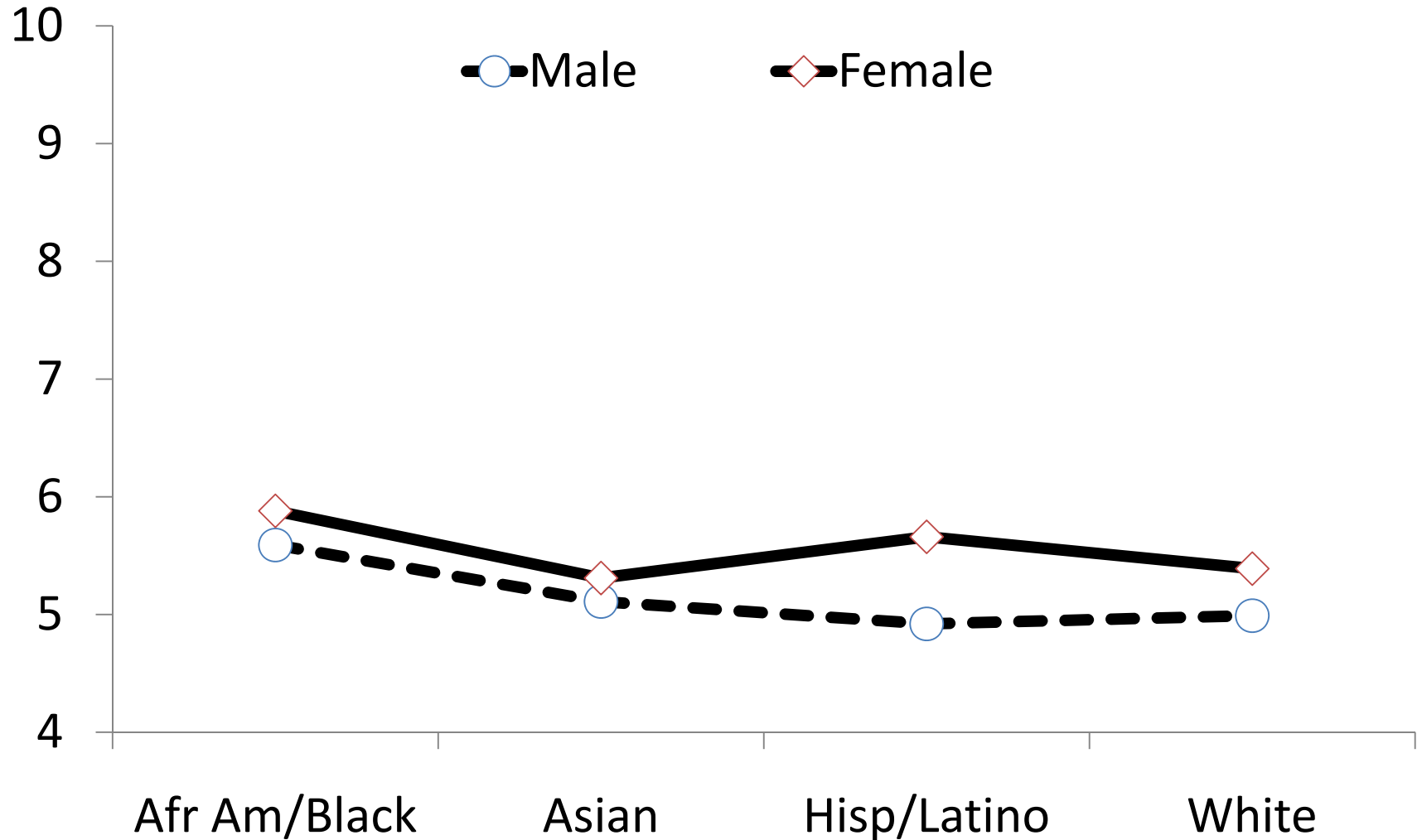
HS Academic Engagement by Ethnicity



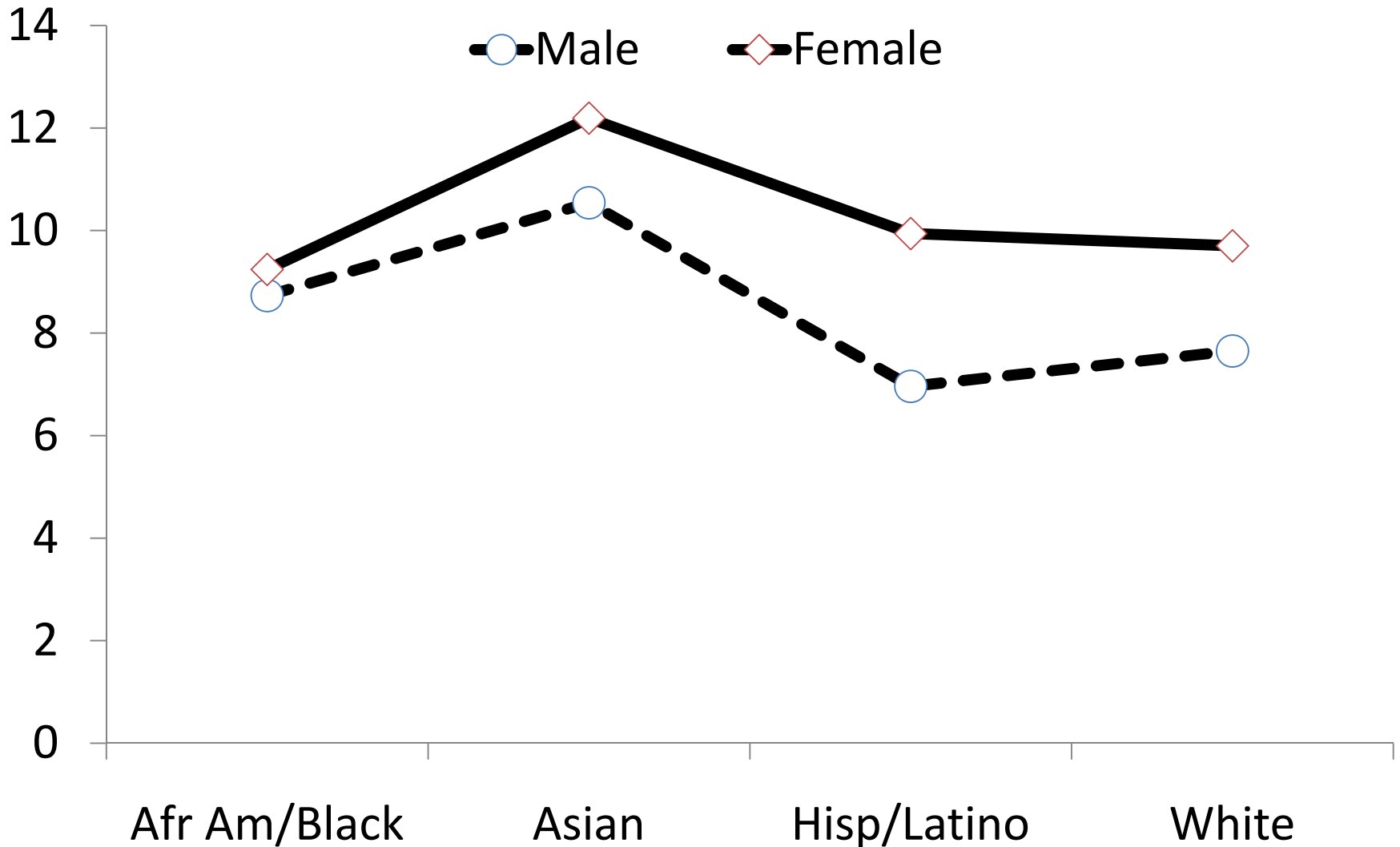
Hours per week in HS Studying by Ethnicity



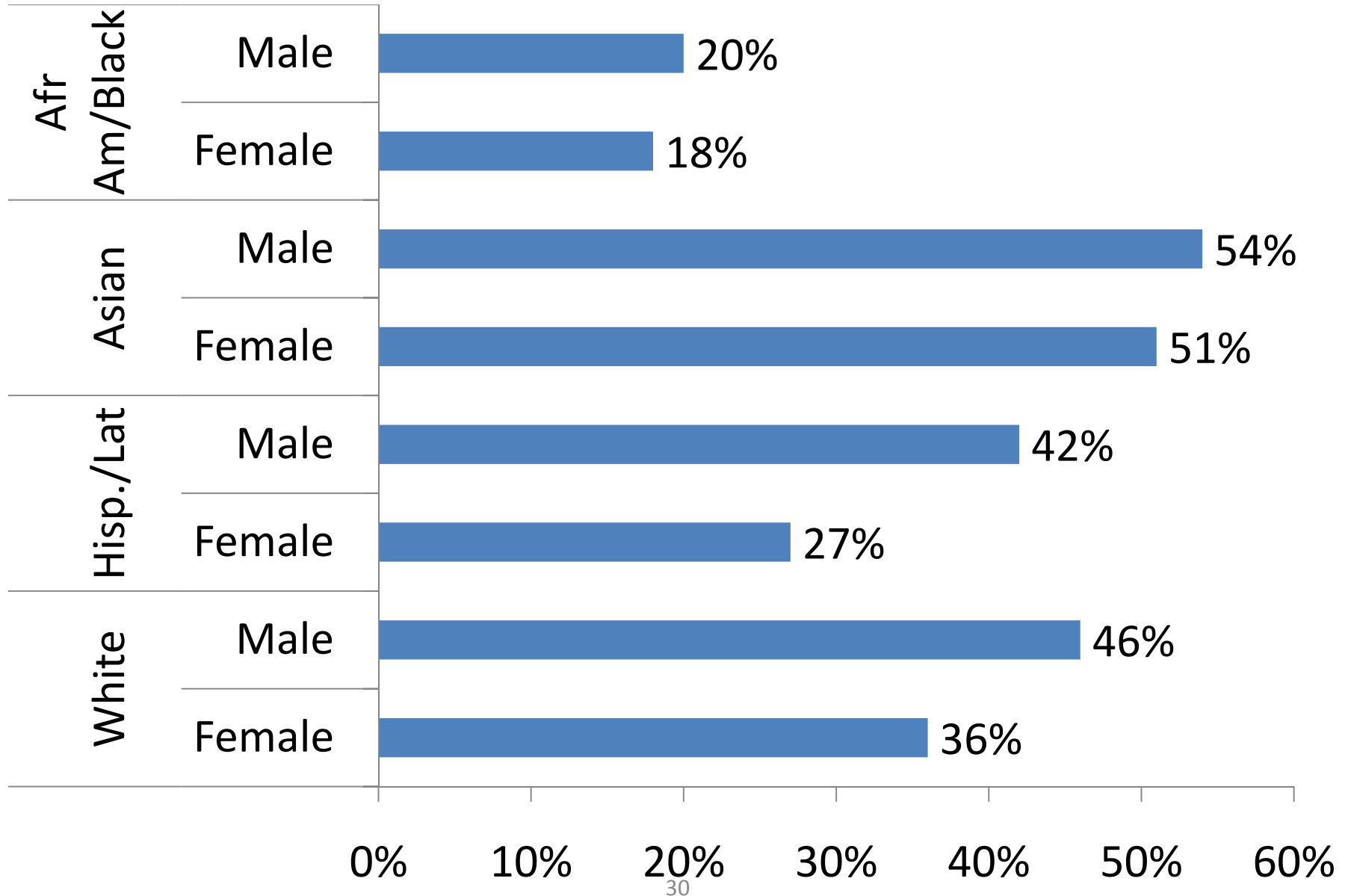
High school engagement by ethnicity and gender



Hours per week studying by ethnicity and gender.



Pass HS Calculus by Gender and Ethnicity



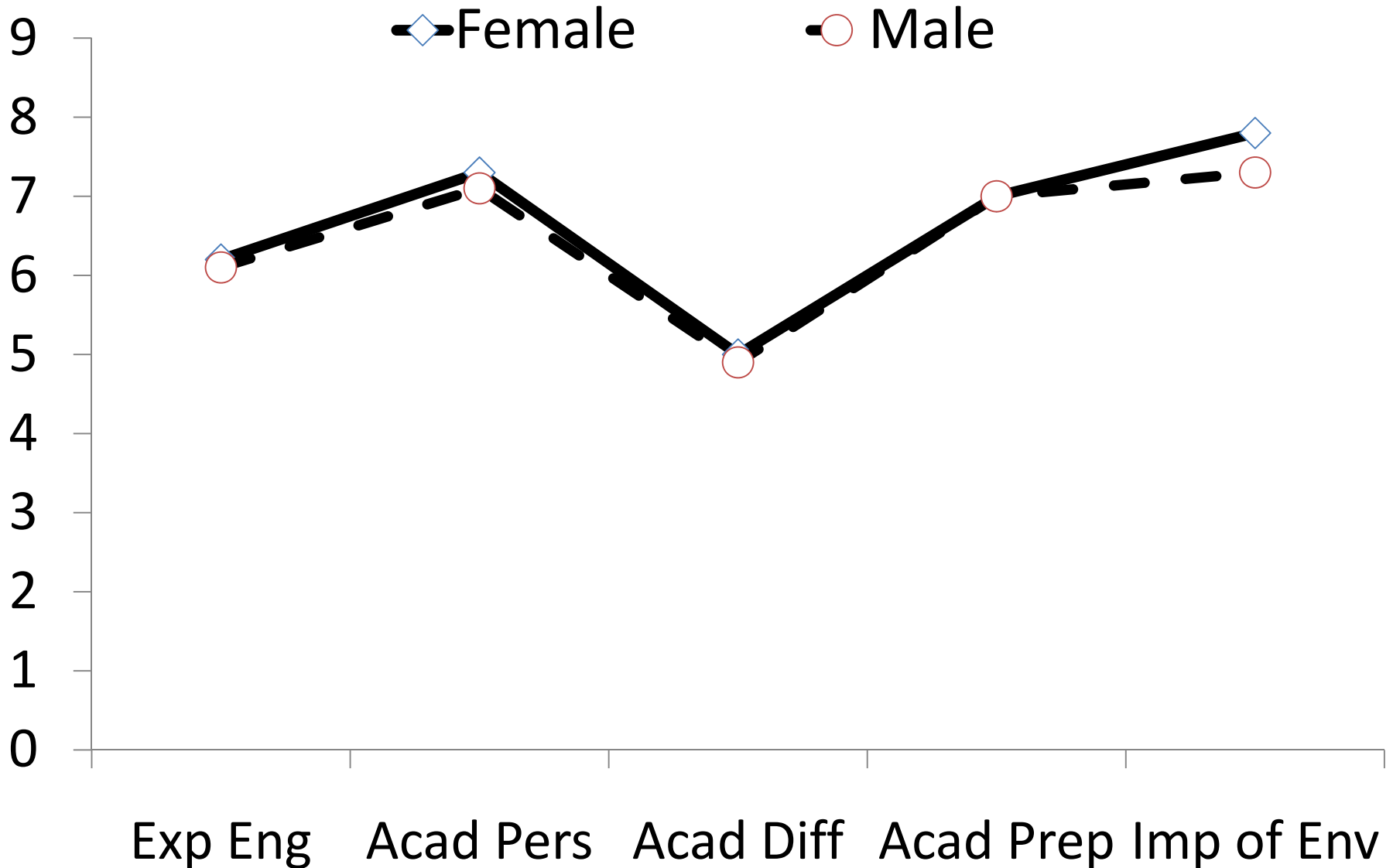
Summary of Research Question 2

- *SAT/ACT: African American/Black significantly lower*
- *Less than 20% of African American/Black pass calculus*
- *However, African American/Black report highest levels of HS academic engagement*
- *Asian students reported highest levels of HS studying*
- *White females reported significantly higher levels of HS academic engagement and hours studying*
- *There was a 10%-15% gap in passing calculus for Hispanic/Latina and White females*

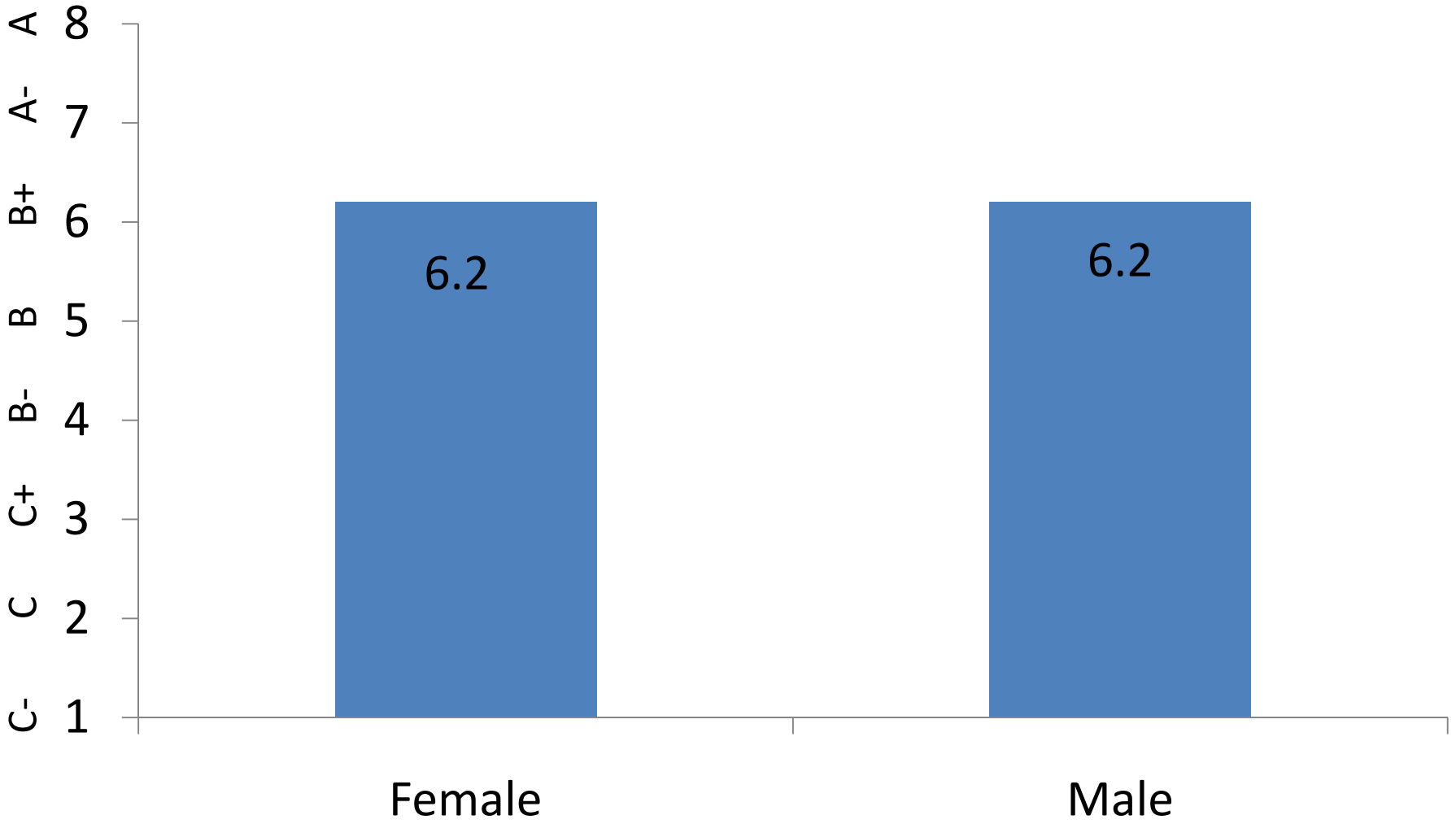
Research Question 3

Do individual factors related with their expected first-year experiences (expected academic engagement, academic persistence, academic difficulty, academic preparation, importance of campus environment, expected grades, and expected hours per week preparing for class) differ between gender and ethnicity?

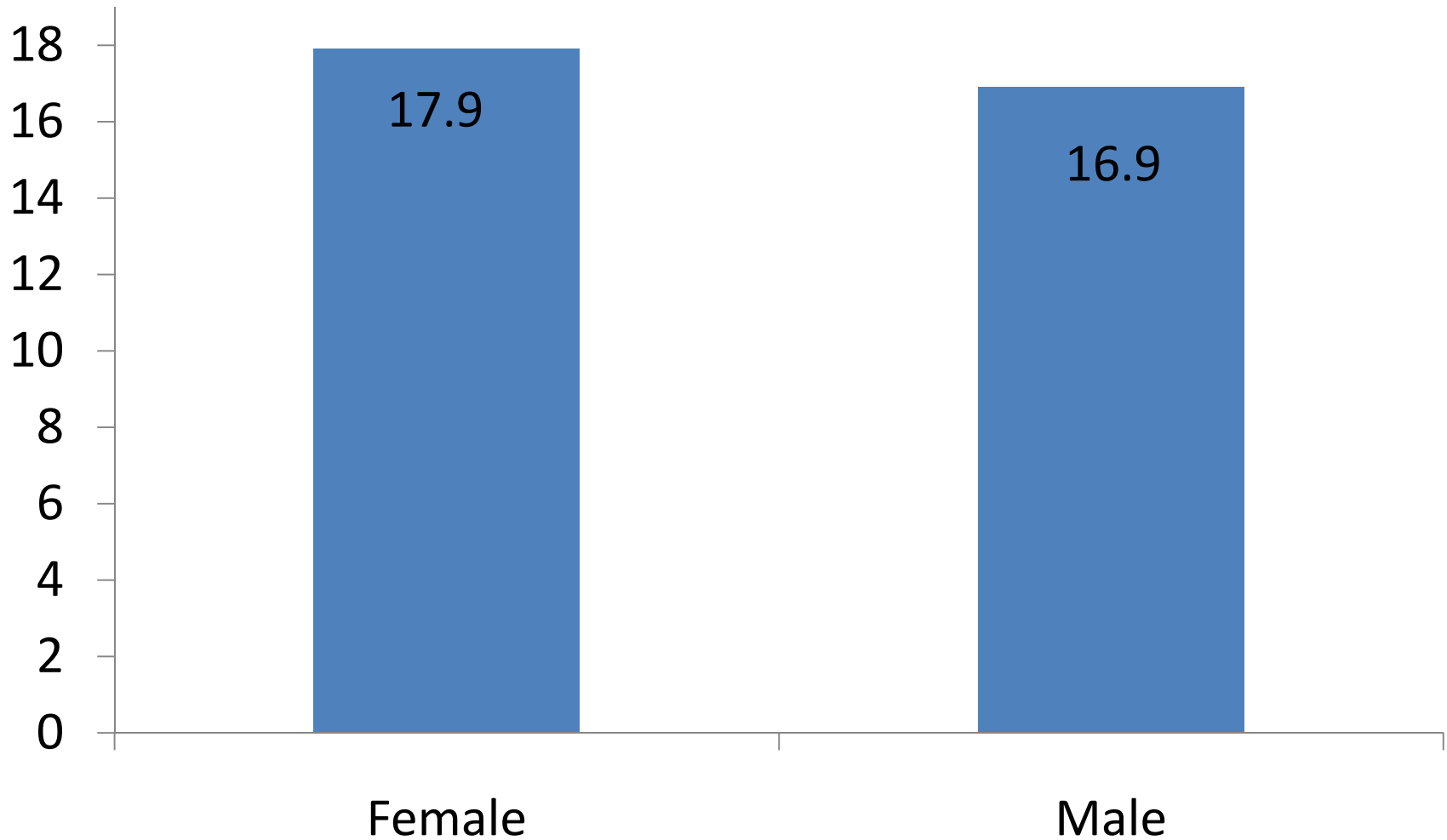
Expected FY Experiences by Gender



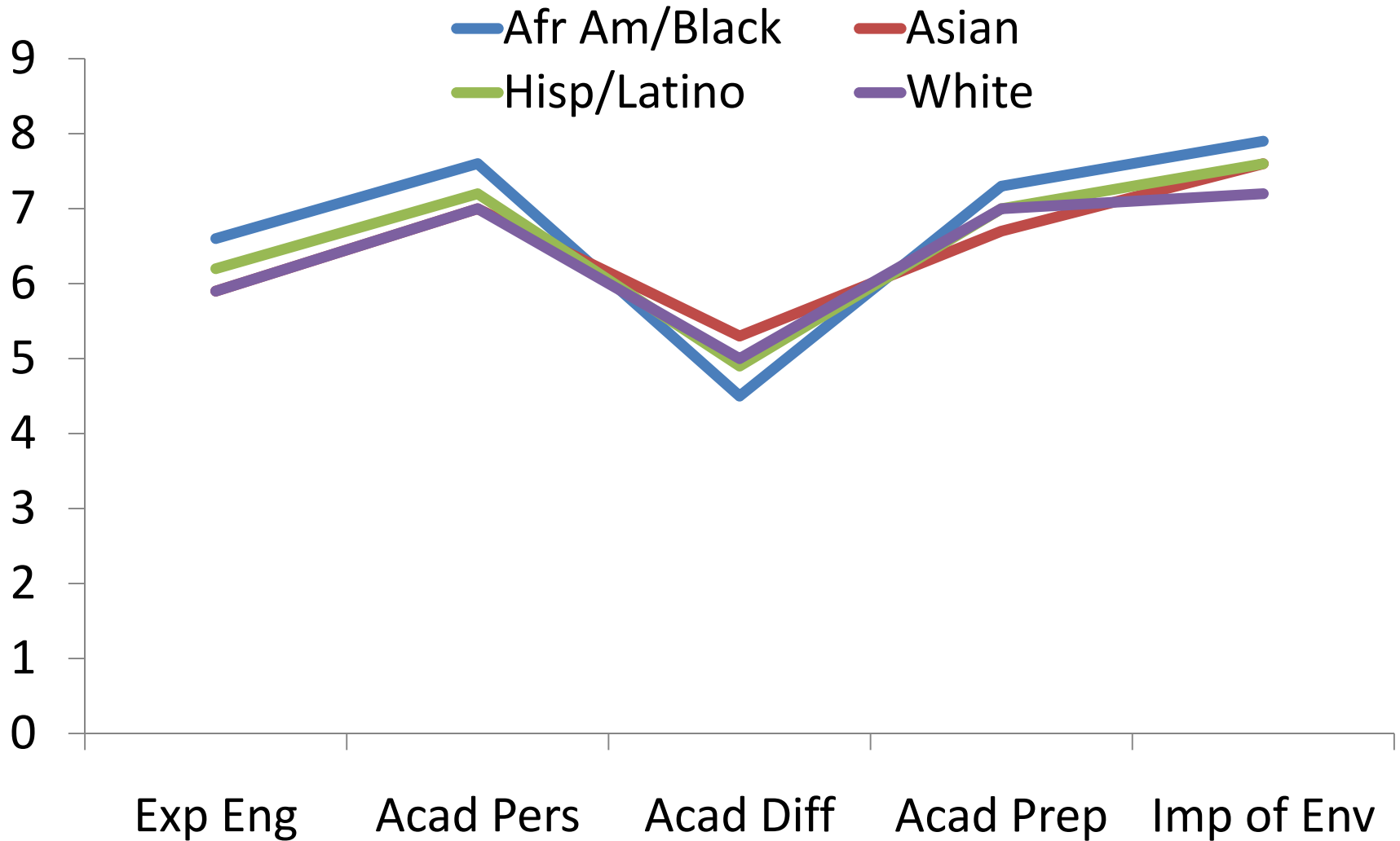
Expected Grades by Gender



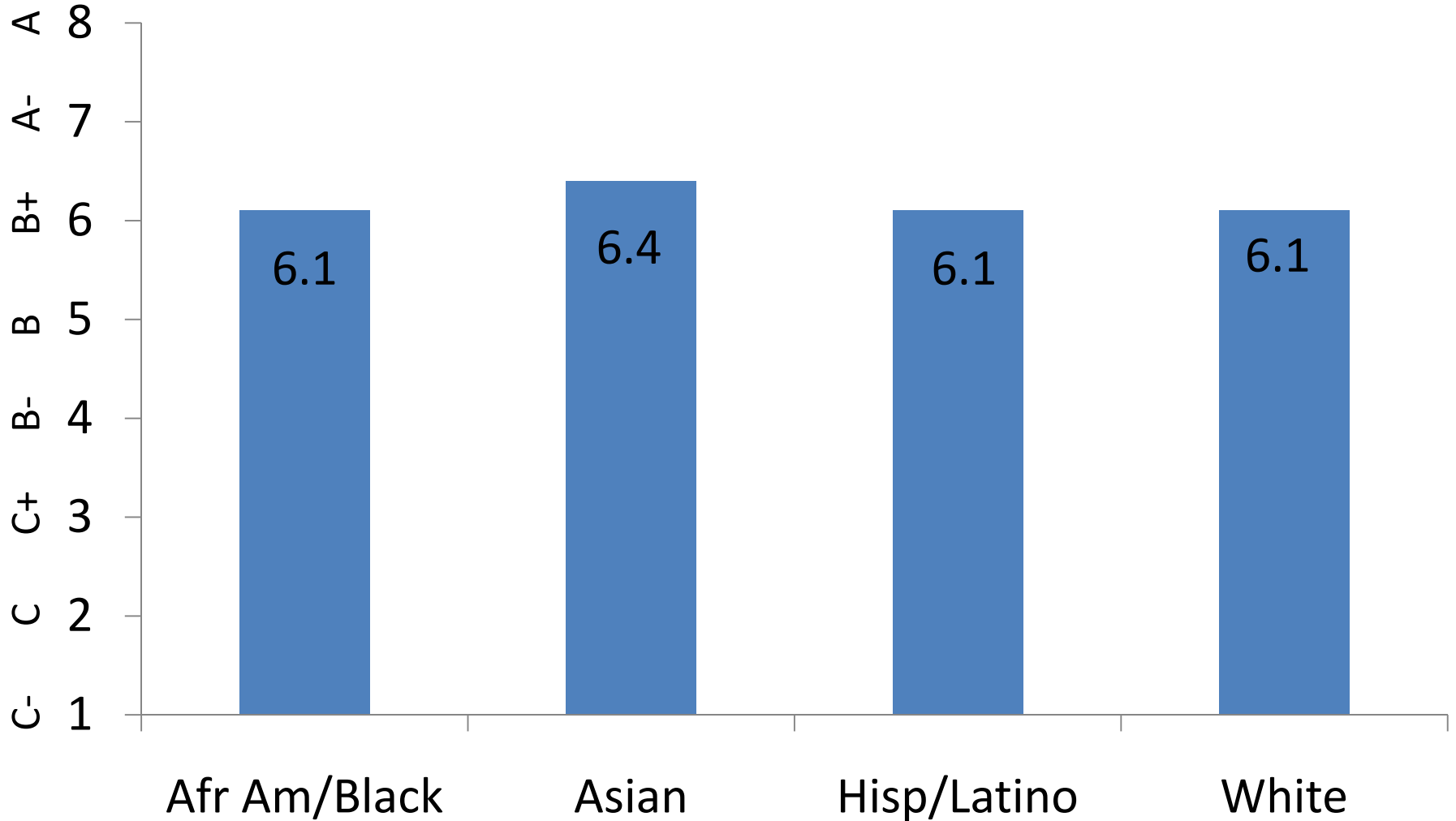
Expected Hrs/Week Studying by Gender



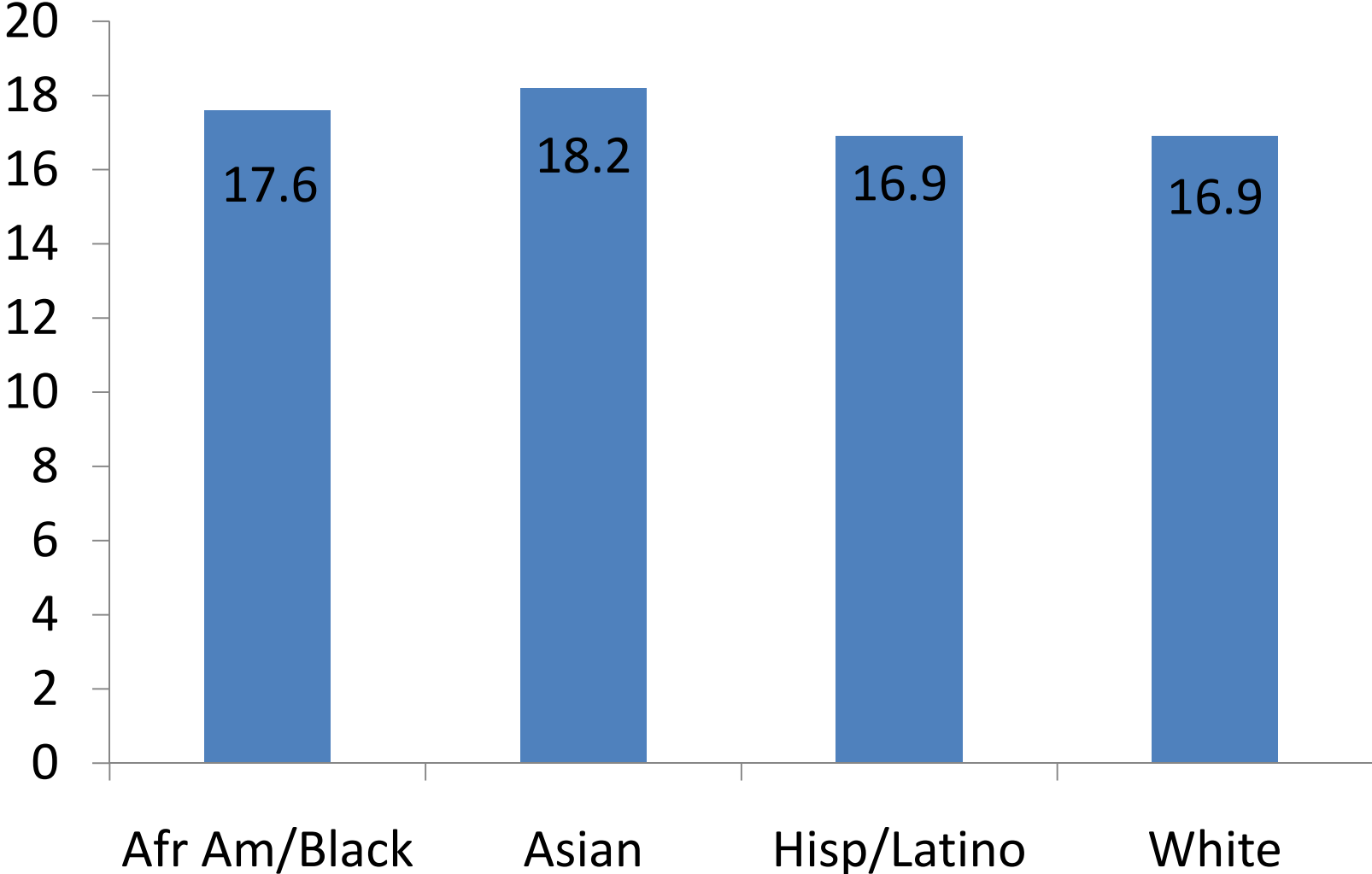
Expected FY Experiences by Ethnicity



Expected FY Grades by Ethnicity



Expected Hrs/Week Studying by Ethnicity



Summary Research Question 3

- Overall, expectations for engagement and grades uniform across gender
- Females do expect to spend more time studying
- African American/Black students report higher levels of exp eng, persistence, importance of campus environment and lower levels of academic difficulty

Discussion - 1

- Expanding the representation of women and students of color in STEM fields is an important educational and national goal.
- Early educational experiences, including math course-taking and performance on standardized tests such as the SAT Math, are key factors in students' entry to and success in the STEM pipeline, but not all students in STEM start out equally on a couple of key precollege factors known to influence success in STEM fields, specifically success in high school calculus.

Discussion - 2

- White and Latina women and Black/African American college students are entering STEM majors with less preparation in mathematics.
- All students entering STEM fields are likely to need to make adjustments in their study habits and academic behaviors to succeed in STEM --white males and Latinos spend the fewest hours studying in HS, and the widest gender gap is between Latinos and Latinas; these students may need the most guidance to alter their established study habits. First year of college is a critical time.

Discussion - 3

- Black/African American students have developed greater sense of the value of taking advantage of support resources in the first year. However, these students also have low levels of perceived academic difficulty. These two findings suggest a potential mismatch, in that even if African American students will use support resources, they may not recognize that they are in difficulty early enough to know they need to use these resources.

Discussion - 4

- All entering students in STEM fields have fairly high expectations for engagement in behaviors associated with learning and development – women have higher expectations for academic engagement, academic persistence and difficulty, than men.
- Showing newcomers what they must do to succeed and familiarizing students with support resources in college is important, it may not be sufficient. Student success in challenging fields like STEM, may require additional infrastructure of support, including summer bridge programs, STEM learning communities, early warning systems for high failure rate courses, redundant safety nets, science learning and tutoring centers.

Some Questions for IR



- How do these data comport with the characteristics and experiences of entering students in STEM majors at your institution?
- What do these findings suggest for IR and for educators interested in underrepresented students in STEM fields?
- What data do you use to examine the status of underrepresented students in STEM fields?
- What other questions might be explored to better understand entering student experiences and expectations relative to their success in STEM majors?

Questions?



Thank You

James S. Cole

Jillian Kinzie

Presentation and paper at:

<http://nsse.iub.edu/html/pubs.cfm>

Or contact Jim Cole at colejs@indiana.edu

Indiana University Center for
Postsecondary Research

www.nsse.iub.edu

866-435-6773

nsse@iub.edu