

# Exploring Predictors of Computer Science Outcomes among Underrepresented High School Students of Color

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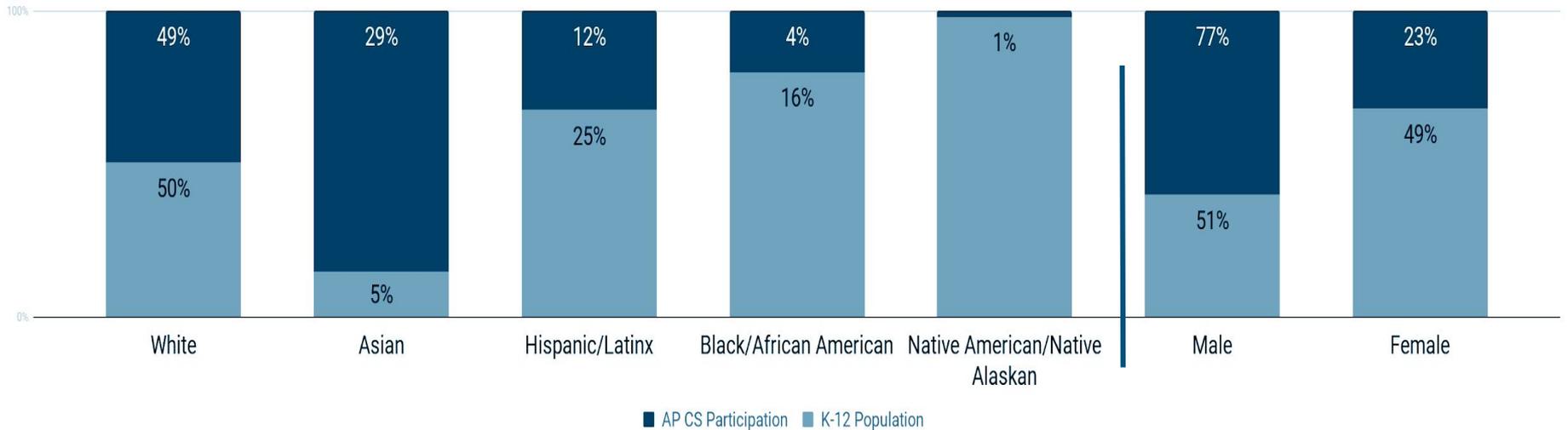
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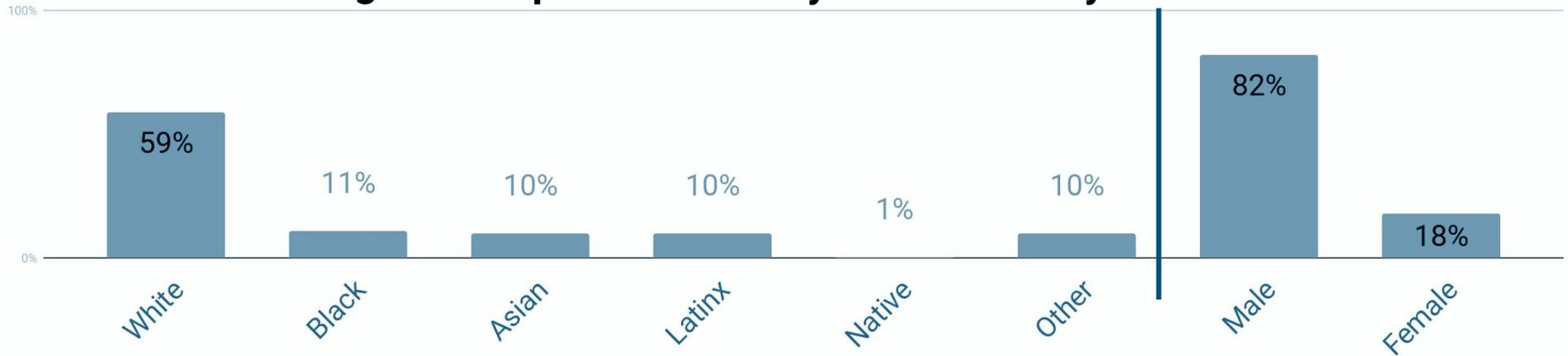
# Underrepresentation in Computer Science: High School

## AP CS Test-Takers by Race/Ethnicity and Gender



# Underrepresentation in Computer Science: Post-Secondary

**CS Degree Completion Rates by Race/Ethnicity and Gender**



# Barriers to Participation

A complex set of **structural** and **psychosocial** barriers create significant obstacles to participation for women and students of color in computing, and creating vast disparities.



# Background Research

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- Exposure to a **short-term** (5 week) CS intervention can significantly increase the CS engagement and aspirations of high school students (Scott et al., 2016).
- **Repeated exposure** to CS intervention (attending 2 summers) produces even greater growth in CS outcomes (Scott, Martin, McAlear, 2017)
- A significant “**Double-Bind**” exists and starts early for girls of color (Malcom, 1975), who are less likely to aspire to pursue computing and much less likely to major in CS in college than their male peers (Scott et al., 2017).

# Exploratory Predictive Model

## DEMOGRAPHIC VARIABLES

- Race/Ethnicity
- SES
- Prior CS Coursework
- GPA

## PSYCHOSOCIAL VARIABLES

- Math Engagement
- Science Engagement
- Self-Efficacy
- Social Justice Orientation

## INTERVENTION VARIABLES

- CS Peer Networks
- CS Role Models
- Social Justice Orientation
- Sense of Community

## SHORT-TERM OUTCOMES

- CS Engagement
- CS Aspirations
- CS Competency
- Persistence in CS
  - Intention to Major in CS

## LONG-TERM OUTCOMES

- Persistence in CS
  - CS Major
  - CS Degree Completion
  - Entry to Computing Workforce
  - Persistence in Computing Workforce

# Research Questions

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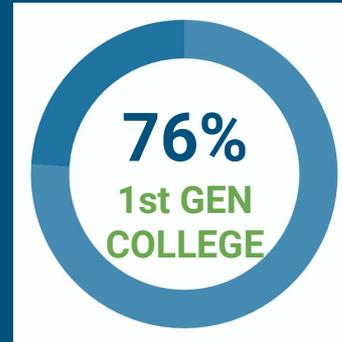
To increase understanding of **predictors of CS outcomes** and explore the impact of specific **interventions on CS outcomes**, we explored the following questions:

- (1) What demographic, psychosocial, and intervention variables are predictive of computer science engagement, aspirations, and competency *at baseline*?
- (2) Which demographic, psychosocial, and intervention variables predict the *greatest gains* in computer science outcomes over the course of a program?

# Study Sample

(n=205)

	%
<b>Gender</b>	
Male	53%
Female	47%
<b>Ethnicity</b>	
African American/Black	34%
Latinx	52%
Southeast Asian/Native American/Multiple Races	14%



# Data Collection and Analysis

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- Instruments:

- Pre/post program survey
- Pre/post CS assessments

- Variables:

- Race/ethnicity, Gender, Years in Program, FRPL-status, GPA, prior CS coursework
- Psychosocial and intervention variables (**predictors**)
  - Includes STEM engagement, self-efficacy, diverse CS networks and supports, social justice orientation
- Computer science-related variables (**outcomes**)
  - Includes CS engagement, aspirations, competency

- Analyses:

- To test relationships between predictor & outcome variables, hierarchical multiple regression models were examined.

# Results

	Pre CS Engage.	Pre CS Aspir.	Pre CS Comp.	Gains in CS Engage.	Gains in CS Aspir.	Gains in CS Comp.
Gender	✓✓✓	✓			✓	
Years in Program						✓
Ethnicity	✓	✓✓				
GPA			✓✓			✓✓✓
Prior CS Coursework				✓		

✓ =  $p < .05$ ; ✓✓ =  $p < .01$ ; ✓✓✓ =  $p < .001$

Note: Analyses for free & reduced price lunch eligibility yielded no significance.

	Pre CS Engage.	Pre CS Aspir.	Pre CS Comp.	Gains in CS Engage.	Gains in CS Aspir.	Gains in CS Comp.
<b>Social Justice Orientation</b>	✓✓	✓✓				
<b>Access to CS Role Models</b>	✓✓✓	✓✓✓			✓✓	
<b>Access to Peer Networks</b>	✓✓✓	✓✓✓				
<b>Overall Self-Efficacy</b>		✓				
<b>Math Engagement</b>		✓				
<b>Science Engagement</b>				✓		
<b>STEM Confidence Gains</b>				✓		
<b>Sense of Classroom Community</b>						✓✓
<b>Sense of Residential Community</b>						✓✓

✓ =  $p < .05$ ; ✓✓ =  $p < .01$ ; ✓✓✓ =  $p < .001$

*Note 1: Analyses for Ethnic Identity yielded no significance.*

*Note 2: Analyses for CS Engagement and Aspirations for CS Competency yield no significance.*

# Significance: Improving CS Outcomes for Students of Color

- **Gender Disparities:** Consistent with previous studies, female students were significantly less likely to be engaged with CS & to aspire to pursue CS than their male counterparts. Yet no significant gender differences were seen in baseline levels of competency or in growth in CS competency, suggesting that ability is not a key barrier to women of color participating & persisting in computing and interventions must focus on social/psychological variables.
- **Role Models and Peer Networks are Critical:** Exposure to role models and immersion in supportive networks of peers are significant predictors of in CS engagement & aspirations. Additional environmental intervention variables, including feeling a sense of community in the classroom & the program, increased CS competency gains, suggesting the classroom environment is critically important.
- Broadening participation necessitates strategies that effectively target:
  - Gender disparities in engagement & aspirations for underrepresented students of color;
  - Classroom/program environments & increased access to role models and peer networks;
  - Specific strategies for each outcome-- engagement, aspiration, & competency

# Limitations and Future Directions

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- Consider intersectionality of demographics in CS outcomes.
  - Future direction: Analyze data to look at predictors of CS outcomes at the intersection of gender and race/ethnicity
- Current model for CS Competency, although significant, does not explain a large amount of variance. A similar observation is seen for all three gains variables.
  - Future direction: Consider additional variables that impact CS competency and CS gains.
- Consider the effect of key variables on long-term persistence within the CS field.
  - Future direction includes longitudinal analysis of student persistence through college and career in CS using alumni survey data

Thank you!

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