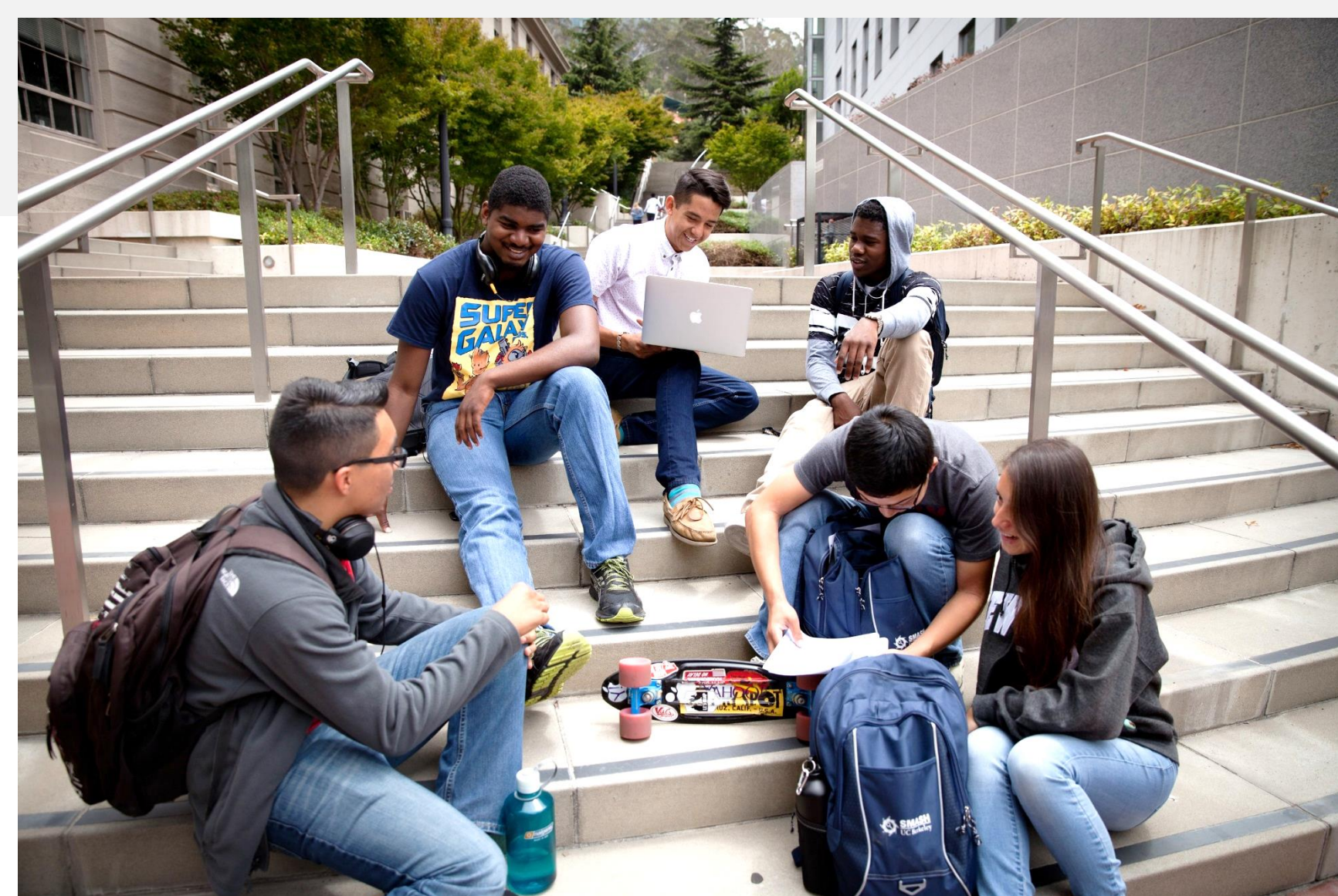# Peer Network Effects and Persistence in Pursuit of STEM Higher Education for Underrepresented Groups

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Abstract

The Level Playing Field Institute has created programmatic, curricular and pedagogical interventions to increase the entrance, retention, and success in Science, Technology, Engineering, and Mathematics (STEM) fields in higher education for underrepresented students of color. Part of the support structure created for underrepresented students includes fostering close relationships within cohorts of peers of color who share similar socioeconomic backgrounds and college and career aspirations. Peer networks reduce barriers facing low-income, first-generation students by bolstering the motivational support provided to students as they navigate barriers in STEM. Findings demonstrate increased STEM motivation outcomes for this population, particularly within Computer Science college majors. These findings underscore the broader need to deepen cohort interactivity to improve STEM higher education outcomes for underrepresented students of color.

Introduction

The National Science Foundation (NSF), among other institutions, agencies and stakeholders, has issued a framework of support and initiatives to increase diversity and inclusion in the fields of Science, Technology, Engineering, and Mathematics (STEM; NSF, 2008, 2011) and address historic underrepresentation of minority demographic groups. For example, African Americans and Latinos combined earn just 9% of all science and engineering degrees and represent only 11% of the entire science and engineering workforce (NSF, 2011). Replicating effective interventions at all levels is critical to ensuring that the STEM workforce reflects the diversity of the general population.

Forms of social support, including the receipt of mentoring, counseling/advising, role models, cultural/family capital and peer networks of underrepresented students have been linked to their persistence in STEM (Palmer et al, 2011; Grandy 1998; Scott and Martin ,2014). Peer support networks for underrepresented groups in STEM higher education have been theorized to operate on different vectors of persistence, including shaping self-efficacy within STEM (Figueroa, Hurtado et al, 2015); the motivations of African American students in STEM (Hurtado et al, 2009) and, academic support in addition to positive social support (Palmer et al, 2011). Scant scholarly attention, however, has been paid to the role of gender and racial identities to maintaining a peer support network in STEM studies. This study therefore examined the correlations between the peer networks forged in a secondary STEM program for underrepresented youth, gender/racial identities and STEM undergraduate studies, with a specific focus on Computer Science majors.

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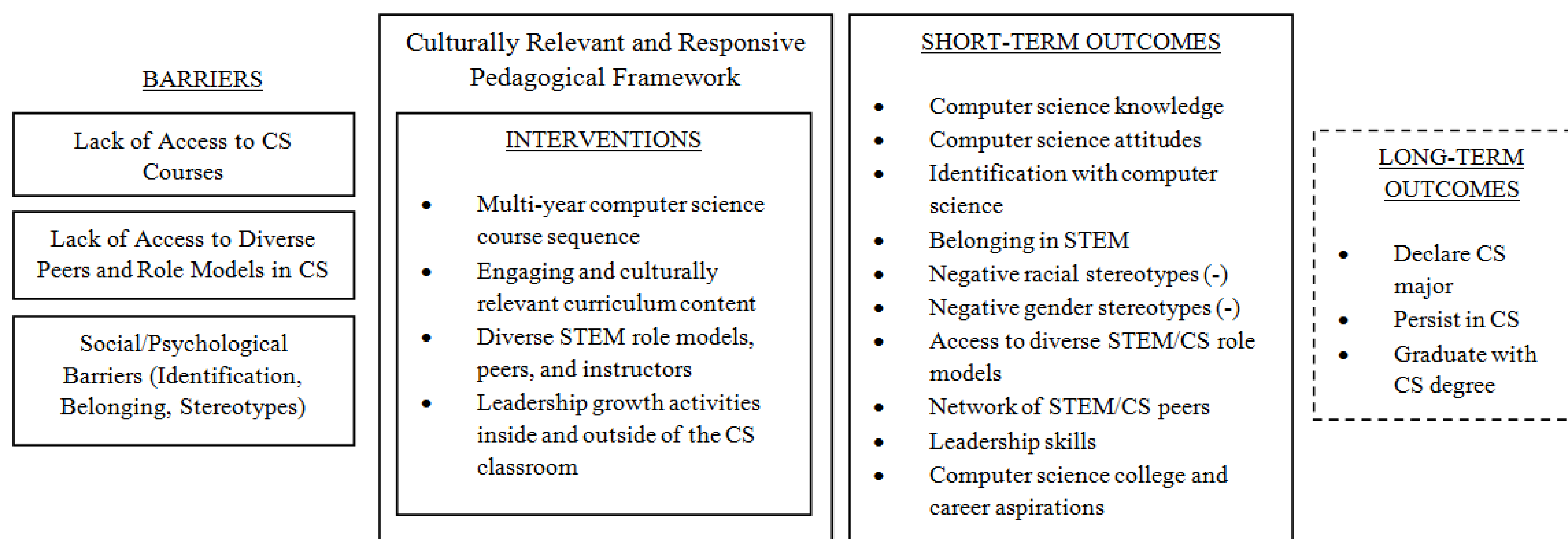
SMASH Academy Alumni Context & Outcomes

SMASH Academy:
- a 5-week, 3-year summer residential STEM program held at UC Berkeley, Stanford, and UCLA.
- 225 current students
- 81% FRPL-eligible, 75% First Generation College, 88% Af-Am and Latino/a

SMASH Academy Alumni:
- Programming includes a professional mentoring program, an alumni reunion and networking event, and regular messages
- 377 alumni
- 63% FRPL-eligible, 65% First Generation College, 77% Af-Am and Latino/a

SMASH Academy Computer Science Conceptual Framework

BARRIERS
- Lack of Access to CS Courses
- Lack of Access to Diverse Peers and Role Models in CS
- Social/Psychological Barriers (Identification, Belonging, Stereotypes)

Culturally Relevant and Responsive Pedagogical Framework

INTERVENTIONS
- Multi-year computer science course sequence
- Engaging and culturally relevant curriculum content
- Diverse STEM role models, peers, and instructors
- Leadership growth activities inside and outside of the CS classroom

SHORT-TERM OUTCOMES
- Computer science knowledge
- Computer science attitudes
- Identification with computer science
- Belonging in STEM
- Negative racial stereotypes (-)
- Negative gender stereotypes (-)
- Access to diverse STEM/CS role models
- Network of STEM/CS peers
- Leadership skills
- Computer science college and career aspirations

LONG-TERM OUTCOMES
- Declare CS major
- Persist in CS
- Graduate with CS degree

SMASH ALUMNI OUTCOMES (HS Graduation Class 2007-2015)		% of Alumni
Current Declared Major (All Students)	STEM Major	68%
	Non-STEM Major	29%
	Undecided	3%
Current Declared Major (Freshmen Only)*	STEM Major	74%
	Computer Science	19%
	Non-STEM Major	20%
	Undecided	6%
Undergraduate Major, Highest Frequency	Computer Science	12% (28/236)
Persistence in STEM**	Intended to Major in STEM while in HS	79%
	Intended to Major in STEM in HS and did in Year 1 of college	74%
	Declared STEM major as freshman and persisted beyond Year 1 in STEM (current sophomores or above)	84% (27/32)
	Declared STEM as freshman and persisted beyond Year 2 in STEM major (current juniors or above)	73% (19/26)
	Declared STEM as freshman and persisted beyond Year 3 in STEM major (current seniors or above)	63% (30/48)

*By comparison, only 23% of all U.S. college freshmen declare STEM majors (including high-income, non first generation college students) (U.S. Dept. of Education, Percent of Bachelor's Degrees Conferred in STEM Fields, 2009).
**Persistence rates were calculated by examining year one, year two, and year three majors for alumni who declared STEM as a freshman. By comparison, non-SMASH Latino and African-American students who enter college as STEM majors have 4-year STEM degree completion rates of just 15%, and 13%, respectively (Higher Education Research Institute, Bachelor's Degree Completion Rates among Initial STEM Majors, 2010).
Note: Data is based on the 261 alumni who responded to the alumni survey. The above include responses for only those alumni for whom there are available data. Due to the variation in denominator by question, percentages are reported within this table.

Methods and Findings

Collected and analyzed demographic, college major and attainment data from 261 SMASH Alumni. Data from four focus groups of Alumni (n=16) were also coded and analyzed.

Reports that peer influence affects STEM persistence were significantly higher in STEM undergraduate majors (U=4384, p=.02)
- Computer Science majors were more likely to report that they have peers to study with or ask about classes (87% overall vs. 93% for CS majors)
- One alum and Computer Science major noted in the focus group: "knowing that there are more SMASH alumni out there doing similar majors keeps me motivated. It makes me not want to drop out of the major [CS] because I don't want to let my SMASH people down."

Ethnicity/race identities (not gender, however) are significantly linked to the maintenance and attainment of social support in college:
- A Kruskal-Wallis H test showed that there is a statistically significant difference in reports of having at least one mentor (including upperclassmen) between students of different ethnic/racial identities, with a mean rank score of 52.50 for Cambodians, Filipino, Lao and Singaporean students and 85.14 for Latino/a students.
- Significant differences were also found between students with African-American and Latino/a ethnic/racial identities and their connection with at least one other SMASH Alumni (U=2471, p=.015)
- While gender was not significantly linked to social support in survey data, African-American female alumni in focus groups reported more incidents of microaggressions and social isolation on their campus and within their major; 2 out of 7 (29%) reported dropping their STEM major due to lack of social support from students and faculty.

Future Research

- Employing and evaluating interventions to increase and sustain peer network formation for African-American STEM students.
- Examining the intersection of ethnic/racial and gender identities and the creation and maintenance of peer support networks for underrepresented youth of color.

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