PURM
Perspectives on Undergraduate Research and Mentoring

Near-peer STEM Mentoring Offers Unexpected Benefits for Mentors from Traditionally Underrepresented Backgrounds

Gloriana Trujillo, San Francisco State University, US
Pauline G. Aguinaldo, San Francisco State University, US
Chelsie Anderson, San Francisco State University, US
Julian Bustamante, San Francisco State University, US
Diego R. Gelsinger, San Francisco State University, US
Maria J. Pastor, San Francisco State University, US
Jeanette Wright, San Francisco State University, US
Leticia Márquez-Magaña, San Francisco State University, US
Blake Riggs, San Francisco State University, US, riggs@sfsu.edu

The practice and perpetuation of scientific research requires that incumbent scientists train junior investigators. In this way, new investigators gain skills and competencies necessary to engage in scientific research. Moreover, the ability to win grants and publish papers improves with effective mentoring (Palepu et al., 1996; Schapira et al.,1992; Steiner et al., 2002; Wingard et al., 2004). Unfortunately, both faculty and student researchers from groups underrepresented in the sciences report a lack of effective mentoring that can limit their participation and success in research (Beech et al., 2013; Ginther et al., 2011). At the undergraduate level inadequate mentoring can result in poor research experiences and exit from science (Johnson, 2007). While inadequate research mentoring can cause undergraduates to leave science, technology, engineering and math (STEM) majors, the primary cause of their exit is poor teaching, which is exacerbated for underrepresented minority (URM) students in science (Seymour et al., 1997). Populations traditionally underrepresented in STEM in the United States include students from racial and ethnic minority groups such as Native American, Hispanic/Latin@, and Black/African-American. Both of these barriers to undergraduate retention in STEM can be overcome by a near-peer mentoring approach as documented in this dialogue. Near-peer relationships are characterized by the pairing of individuals who are slightly more advanced in learning and/or training with individuals who are less advanced. Our formal and informal near-peer mentoring approaches provided URM undergraduates enrolled in an introductory biology or upper division research skills course with practical information and psychosocial support to succeed in these activities.

Near-peer mentoring approaches are grounded by the understanding that mentoring is a collaborative process that requires engagement of both teacher and learner. Ideally, mentors/teachers and mentees/learners engage as partners through reciprocal activities to advance the career aspirations of both (Hunt & Michael, 1983). Consequently, effective mentoring requires more than occasional meetings between a mentor and mentee and requires that mentees are not passive recipients of a mentor's guidance. It is a dynamic reciprocal relationship that changes over time and benefits both parties. This mutually beneficial relationship can occur in learning and/or training research environments where both the mentee and mentor are viewed as

"learners and trainees." In this context the mentee acquires research knowledge and skills needed for scientific productivity, as well as career-related knowledge essential to professional advancement. On the other hand, the mentor gains hands-on experience in effectively supporting the academic and professional growth of junior investigators, thereby honing their skills to effectively guide research projects to success. While these benefits are commonly accepted for senior research mentors, in this report we find unexpected benefits to mentors engaged in near-peer mentoring. These benefits are similar to those found for peer-led learning environments.

Studies find that peer-led instruction is effective in increasing student persistence, retention and student learning. Both leaders and students benefit from the enhanced learning experience (Brownell & Swaner, 2010; Cracolice & Deming, 2001; Lave & Winger, 1991; Quitadamo, et al., 2009). Peer leaders increase their understanding of the subject matter, develop an increased sense of responsibility and confidence, improve their oral communication skills, and develop an enjoyment of teaching and a greater enthusiasm for pursuing a degree in STEM (Cracolice a&nd Deming, 2001; Hamid, 2001; Smith et al., 2009).

Research experiences improve academic performance and sustain interest in research careers for undergraduates in STEM (Fechheimer et al., 2011; Russell et al., 2007). However, the inability of most colleges and universities to provide research experiences to all undergraduates results in unequal access to this valuable activity (Eagan, et al. 2013; Lopatto, 2004). For students who are traditionally underrepresented in STEM (TURS), mentors may play an essential role in supporting the advancement of their research careers. For example, studies have shown that inadequate mentoring can adversely affect performance in research opportunities and cause TURS students to leave careers in STEM fields (Johnson, 2007). Inadequate mentorship of TURS students engaged in undergraduate research limits the ability of this evidence-based approach to increase the diversity of the scientific workforce.

Effective research mentoring has been shown to enhance recruitment and retention of TURS students and increases persistence towards research careers (Gregerman, et al., 1998; Hathaway, et al., 2002). Underrepresented students who are mentored display higher retention rates (Alberta et al., 2001), with effective mentoring reported as a key factor in completing an advanced degree (Solarzano, 1993). In fact, several studies of minority and non-minority medical faculty find that the quality of mentoring is linked to increased publication rates, job satisfaction, and career advancement (Palepu et al., 1996; Schapira et al., 1992; Steiner, et al., 2002; Wingard et al., 2004). For underrepresented minority faculty with mentors, studies find that they are more confident and feel better supported in their work and career advancement (Beech et al., 2013).

While benefits to mentees engaged in mentored research experiences are clear, benefits to mentors have not been well documented. For example, while it has been shown that increased productivity among undergraduate research mentees inevitably leads to increased productivity for mentors (Dolan and Johnson, 2009), other benefits are not well studied and are largely anecdotal. Additionally, effective mentors facilitate the recruitment of savvy and dedicated students to the mentor's research program. These benefits can be accrued by senior mentors who lead research programs regardless of minority status, however in this report we examine benefits accrued by near-peer mentors from historically underrepresented groups in science at a university with minority-serving institution status. A minority-serving institution is defined as a college or university with >50% student population of traditionally under-represented students, based on United States federal designations (Li & Carroll, 2007).

Near-peer relationships are characterized by the pairing of individuals who are slightly more advanced in learning and/or training with individuals who are less advanced, and we find that this
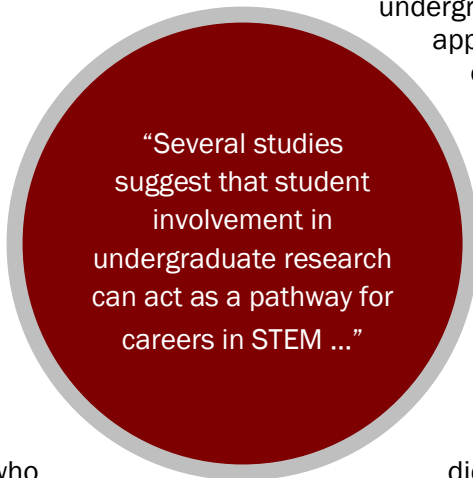
pairing accrued unexpected benefits to the mentors.

Methods
Approach: Informal and Formal Near-Peer Mentoring
There has been an increase in the numbers of URM students entering STEM degrees and involved in undergraduate research, however this has not translated into increased numbers of URM professionals in STEM careers. Several studies suggest that student involvement in undergraduate research can act as a pathway to careers in STEM (Lopatto 2007, Russell et al., 2007, Thiry et al., 2011). However, retention of URM students in STEM majors and access to research opportunities persist as major barriers towards completion of degree programs. Here we propose that near-peer mentoring strategies may increase retention rates in STEM majors and provide knowledge and access to research experiences. We employed both informal and formal near-peer mentoring strategies to increase exposure to scholarship and undergraduate research opportunities, reduce social isolation, build a support network, and increase self-efficacy.

Informal near-peer mentoring program: Biology Undergraduate Mentor Program (BUMP*). We* implemented an informal near-peer mentoring strategy with lower-division students being mentored by upper division undergraduate students within the Biology department at San Francisco State University. Near-peer mentoring has been used by many universities and educational non-profit organizations and has recently been the focus of a national effort to increase U.S. graduation rates to the highest in the world by 2020 (Nekuda Malik, 2014). In addition, near-peer mentoring has been shown to be extremely successful in the STEM research environment (Tenenbaum et al., 2014). Here, we created the Biology Undergraduate Mentor Program (BUMP), a pilot program that lasted for a year (Fall 2012-13), with four upper-division undergraduate mentors and 16 lower division undergraduate biology majors. This pilot program used an informal approach where mentor/mentee pairs would meet weekly outside of the classroom setting and discuss topics ranging from best study practices to available resources within the department and university. BUMP mentees were selected from the introductory Biology course sequence through an application process, which focused on their first exam score and attendance in the course. The introductory biology course is a large lecture style course with over 275 students enrolled and was selected for the BUMP program because this course has been identified by students who have left the biology major as one of the most difficult courses to navigate, which ultimately led to a change in career. Ideal mentee candidates for BUMP were students who did not perform well on the first exam, but had excellent attendance in the lecture and laboratory sections. BUMP mentors were recruited based on their performance in the introductory course and through recommendation from the instructor. Ideal mentors were not just students who received a top grade in the course, but also students who showed the greatest improvement (i.e. improvement of at least one grade from the midterm to the final) in assignments and exams over the course of the semester. In addition, there was no requirement for the mentors to be involved in any research programs or internships, however mentors received weekly training ranging from introduction of campus and department resources, communication and study skills, and issues surrounding equity and diversity. It is important to note that all mentors in BUMP identified as belonging to a TURS group.

> "Several studies suggest that student involvement in undergraduate research can act as a pathway for careers in STEM ..."

Formal classroom approach: Research skills course. A near-peer mentoring approach was also

implemented in a classroom setting in the fall semesters of 2012-2014. This approach was used to implement the learning objective of mentoring young scientists in the practice of science in a paired "Research Skills" course for upper division undergraduate and masters level students. One of the learning objectives for the graduate students was to "gain skills to mentor young scientists in the practice of science." Taken together, this objective was achieved via mentoring workshops for the graduate students, and hands-on experiences in mentoring the undergraduates. Undergraduates enrolled in the course were matched with master's level graduate students (2-3 undergraduates per masters student), to engage in a series of workshops to both demystify and provide skills for the practice of biological research. The workshops were systematically organized to align with the typical skills needed for engaging in a new research project. Specifically, the near-peer mentoring groups worked collaboratively to conduct a literature search, design an experiment, hone recordkeeping skills, deliver a journal club presentation, and write a research brief. The focus of these assignments was driven by the topic of the graduate student's research. Thus, in the mentoring groups the graduate students were the more advanced incumbent scientists (mentors), and the undergraduates were the more junior investigators (mentees), thereby creating a near-peer mentoring relationship. To promote success of this relationship, the graduate students additionally participated in workshops on effective mentoring practices, and were encouraged to work together to find their own examples of effective mentors. Given the novelty of this classroom approach, it was important to assess its efficacy. Mentors and mentees were assigned journaling activities to gather evidence regarding the efficacy of the pedagogical approach.

Evaluating the Approach: Collecting and Analyzing Student Voices

To track changes that occurred over the course of the research skills course and the mentoring program, a variety of qualitative assessments were collected. In addition to data from BUMP mentees collected during the semester they participated in the program, BUMP mentors were asked to complete a reflection at the end of the semester in response to a prompt (Question: In what ways has BUMP impacted your professional life thus far?). Mentors of the research skills course (see Appendix A for mentor demographics) were asked to complete reflective journals throughout the course of the semester to periodically assess progress and group dynamics.

In both informal and formal mentoring programs, reflections (including reflective journals) were read at least once before initial analysis. With second or subsequent readings, quotes were highlighted and labeled for particular themes. Reflections were read again without highlighted text to ensure that additional themes or quotes were not omitted. Themes were then clustered into similar groups, depending on relevance. Individual quotes representative of themes were then read for completeness and to ensure context was conveyed correctly. If an individual quote on its own did not appear to convey the theme correctly, the quote was selected from its original context and additional sentences that represented the theme were included. Quotes not used in the text are included in supplemental material (Appendix B).

Results

We found that near-peer mentors from underrepresented groups voiced changes in attitudes and perceptions linked to increased persistence in science. The themes discussed by our mentors included bolstering science identity, building self-efficacy, and boosting sense of belonging. Thus our near-peer mentoring approach appears to not only have benefitted mentees by overcoming some of the limitations imposed by the lack of universally accessible and sometimes poor research experiences, but it also benefitted mentors. In this way our near-peer mentoring approaches amplified efforts to increase diversity and retention in STEM.

Boosting Sense of Belonging

Negative perceptions of a STEM environment as a place where particular students "do not belong"

can lead to poor academic performance and exit from science (Good, et al., 2012; Purdie-Vaughns, et al., 2008; Schmader, et. al., 2008). This is the environment typically faced by students who are historically underrepresented and enrolled in science classes, and it can diminish their perception of the value of STEM (Aronson, et al. 2002; Osborne, 1995; Steele, 1997). In addition, a lack of role models can be a defining factor in generating an imposter syndrome phenomenon in students, directly affecting their sense of belonging within STEM majors (Clance & Imes, 1978; Jackson & Heath, 2014). These outcomes are a result of environmental cues, such as classroom environment facilitated by an instructor, that fail to signal safety and valuation of diversity (Murphy, et al., 2007; Walton & Cohen, 2011). The exit of URM students from STEM comes at the expense of the student's well-being, as well as that of diversity of thought and practice of research within the scientific field. It is common to believe that these factors affect only mentees within the programs, however our findings suggest that many mentors also experience a lack of belonging within their majors and scientific community. Our near-peer mentoring approaches addressed these environmental cues and boosted a sense of belonging not only of our mentees in the programs but the mentors as well, as demonstrated by the voices of the mentors. One mentor in particular stated, "Being one of the first mentors, I think I am helping to shape the program and determine its future goals. That in itself has impacted me greatly, as I feel that I am a part of a community at San Francisco State University."
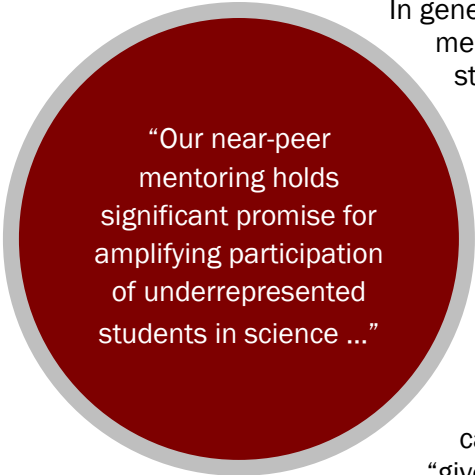
Bolstering Science Identity

Identity can be viewed in one of two ways, either as a social construct (i.e. group affiliation), or as a personal view of self (Fearon, 1999). When we explore our identity in STEM, we look to our community for affirmation as a scientist and to our own personal perception of what defines a scientist. This concept of one's "scientific identity" can be a critical factor in persistence and successful outcomes in research and training towards STEM careers (Carlone & Johnson, 2007). A recent study provides the framework to characterize science identity into three components: recognition; competence; and performance (Trujillo & Tanner, 2014). In reflection essays of the mentors involved in BUMP and the Research Skills course, we found that through mentoring, the mentors showed strong improvement in each of these categories. Reflection from a mentor in the research skills course showed an increase in competence, "In fact, when I realized on the first day of class that I would be a mentor I was scared and apprehensive; I had little confidence in my ability to present information about the scientific research field in a constructive and helpful manner. However, I came to realize over the course of the class that I have actually had more experience in the research field than I have cared to give myself credit for. Even if I feel like an inexperienced and sometimes overwhelmed researcher, I still have a lot offer as a mentor to aspiring scientists like the undergraduates in this class. For instance, many of the undergraduates have not been a part of a lab and the fact that I have actually been a part of a lab and conducted both successful and unsuccessful experiments means that I can give them an introduction to what the day-to-day experience of conducting research is like. I also realized that having been to graduate school interviews and going through the application process to get into the master's program at SFSU are more unique experiences than I had initially considered them to be. There is a lot I am able to help others with in terms of informing them of what to expect and what can make them more successful in preparing for taking the next steps after obtaining an undergraduate degree."

Another mentor reflection displayed increased recognition of science identity through mentorship for success at the next level of their education goals, "Now that I am applying to PhD programs this fall, I feel I have an edge over other applicants because of the skills I have learned from the BUMP program. My mentorship abilities have tightened and reinforced how I present myself professionally, and in addition I know I have real world experience that applies directly to academia. I know that typically when you choose the academia route as a primary investigator you are thrown into an environment where you do not have a lot of mentorship experience. Now that I do, I believe I will be a more effective PI in the future."

Building Self-Efficacy

The reflections of mentors in the research skills course and the mentoring program showed that they had an increase in confidence in scientific research skills or leadership skills. The phenomenon in which an individual has confidence in their ability to do something has been termed self-efficacy (Bandura, 1997). That self-efficacy would be a theme in both informal and formal mentoring environments was expected, as many other cases have reported self-efficacy increases in other contexts (reviewed in Trujillo & Tanner, 2014).

The self-efficacy theme in the reflections referred to a variety of skills or competencies. In certain cases, the expression of increased self-efficacy was explicit, such as with the following mentor in the research skills course, "However, I am sure that either this class or being mentor increased my confidence in talking in class." One mentor in BUMP applied the skills learned as a mentor to being a mentee in another context: "I've very much been mentored here just as much as my mentees have, and by mentoring others I've figured out how to get my own mentoring as well." Another mentor in BUMP clearly illustrated the growth in self-efficacy through mentoring in this quote, "I thought I signed up for a simple tutoring job – which would have been very easy since I had all my papers and materials from that class; when Blake emphasized how this was specifically not supposed to be a tutoring job, I sort of panicked because I suddenly felt unqualified to be somebody's mentor. I had this nagging fear that my mentees wouldn't respect me and I would be completely out of my depth; this was my first ever job and I've always been a follower rather than a leader. But with experience I think I've learned many good and many bad ideas about mentoring, and I am far more confident about my future than I have ever been. In short, BUMP has been full of challenges and many learning experiences that have allowed me to grow and has greatly helped my chances of having a successful professional career."

> "Our near-peer mentoring holds significant promise for amplifying participation of underrepresented students in science ..."

In general, it is likely that mentors developed confidence in areas not mentioned in the reflections. Possible reasons these were not stated more explicitly could be the mentors' perceived importance of these areas, or perhaps the questions addressed within reflection statements were not specific enough.

Impact

In this report we find that near-peer mentors report benefits that include increased sense of belonging and science identity, as well as improved self-efficacy. These factors are important for increasing persistence of URM students in STEM (Trujillo and Tanner, 2014). Another persistence factor that was identified in a study conducted at SF State and that is also captured in our near-peer mentoring approach is the ability to "give back." When 22 women of color enrolled in the Cell and Molecular Biology masters program were asked about their ability to persist in science 73% (16/22) reported that they persisted because they had opportunities to use their science skills to "give back" to their personal ethnic and gender specific communities (Umanzor, 2011). In fact, this communal goal was voiced by several of the mentors in our study, and is an emerging persistence factor for URM students in the sciences (Thomson et al., 2014). Our near-peer mentoring holds significant promise for amplifying participation of underrepresented students in science by positively affecting both mentees and mentors and serving as a vehicle for giving back.

References

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, *38*(2), 113-125.

Bandura, A. (1997). Self-efficacy: The exercise of self-control. New York: Freedman

Beech, B. M., Calles-Escandon, J., Hairston, K. G., Langdon, M. S. E., Latham- Sadler, B. A., & Bell, R. A. (2013). Mentoring programs for underrepresented minority faculty in academic medical centers: a systematic review of the literature. *Academic medicine: journal of the Association of American Medical Colleges*, *88*(4).

Brownell, J. E., & Swaner, L. E. (2010). *Five high-impact practices: Research on learning outcomes, completion, and quality*. Washington, DC: Association of American Colleges & Universities.

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of research in Science teaching, 44*(8), 1187-1218.

Clance, P. R., & Imes, S. A. (1978). The imposter phenomenon in high achieving women: Dynamics and therapeutic intervention. *Psychotherapy: Theory, Research & Practice*, *15*(3), 241.

Cracolice, M. S., & Deming, J. C. (2001). Peer-Led Team Learning. *Science Teacher*, *68*(1), 20-24.

Dolan, E., & Johnson, D. (2009). Toward a holistic view of undergraduate research experiences: an exploratory study of impact on graduate/postdoctoral mentors. *Journal of Science Education and Technology*, *18*(6), 487-500.

Eagan, M. K., Garcia, G. A., Herrera, F., Garibay, J., Hurtado, S., Chang, M J. (2013). Making a difference in science education the impact of undergraduate research programs. *American Educational Research Journal, 50,* 683-713.

Fearon, J. D. (1999). *What is identity (as we now use the word).* Unpublished manuscript, Stanford, CA: Stanford University.

Fechheimer, M., Webber, K., & Kleiber, P. B. (2011). How well do undergraduate research programs promote engagement and success of students?. *CBE-Life Sciences Education*, *10*(2), 156-163.

Ginther, D. K., Schaffer, W. T., Schnell, J., Masimore, B., Liu, F., Haak, L. L., & Kington, R. (2011). Race, ethnicity, and NIH research awards. *Science*, *333*(6045), 1015-1019.

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700.

Gregerman S. (1999). Improving academic success of diverse students through undergraduate research. *Council on Undergraduate Research Quarterly, 20*, 54–59.

Hamid, S. L. (2001). *Peer Leadership: A Primer on Program Essentials. The First-Year Experience Monograph Series No. 32*. National Resource Center for the First-Year Experience and Students in Transition. Columbia, SC: University of South Carolina.

Hathaway, R.. S., Nagda, B. R. A., & Gregerman, S. R. (2002). The relationship of undergraduate research participation to graduate and professional education pursuit: An empirical study. *Journal of College Student Development, 43*(5), 614-631.

Hunt, D. M., & Michael, C. (1983). Mentorship: A career training and development tool. *Academy of management Review*, *8*(3), 475-485.

Jackson, D., & Heath, T. (2014). An antidote to impostor syndrome. *XRDS: Crossroads, The ACM Magazine for Students*, *21*(2), 12-13.

Johnson, A. C. (2007). Unintended consequences: How science professors discourage women of color. *Science Education*, *91*(5), 805-821.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Li, A., & Carroll, D. C. (2007). Characteristics of Minority-Serving Institutions and minority undergraduates enrolled in these institutions: Postsecondary education descriptive analysis report (NCES 2008-156). Washington, DC: National Center for Education Statistics.

Lopatto, D. (2004). Survey of undergraduate research experiences (SURE): First findings. *Cell Biology Education, 3,* 270-277.

Lopatto, D. (2007). Undergraduate research experiences support science career decisions and active learning. *CBE Life Science Education, 6,* 297-306.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat how situational cues affect

women in math, science, and engineering settings. *Psychological Science*, *18*(10), 879-885.

Nekuda Malik, J. A. (2014). STEM mentoring initiative moves forward. *MRS Bulletin*, *39*(08), 656-657.

Palepu, A., Friedman, R. H., Barnett, R. C., Carr, P. L., Ash, A. S., Moskowitz, M. A., & Szalacha, L. (1996). Medical faculty with mentors are more satisfied. *Journal of General Internal Medicine*, *11,* 107.

Osborne, J. W. (1995). Academics, self-esteem and race: A look at the underlying assumptions of the disidentification hypothesis. *Personality and Social Psychology Bulletin 21*(5)*, 449-455.*

Purdie-Vaughns, V., Steele, C. M., Davies, P. G., Ditlmann, R., & Crosby, J. R. (2008). Social identity contingencies: how diversity cues signal threat or safety for African Americans in mainstream institutions. *Journal of Personality and Social Psychology*, *94*(4), 615.

Quitadamo, I. J, Brahler, C. J., and Crouch, G. J. (2009). Peer-led team learning: A prospective method for increasing critical thinking in undergraduate science courses. *Science Educator, 18,* 29-39.

Russell, S. H., Hancock, M. P., & McCullough, J. (2007). Benefits of undergraduate research experiences. *Science*, *316*, 548-549.

Schapira, M. M., Kalet, A., Schwartz, M. D., & Gerrity, M. S. (1992). Mentorship in general internal medicine. *Journal of General Internal Medicine*, *7*(2), 248-251.

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review*, *115,* 336-356.

Seymour, E., Hewitt, N. M., & Friend, C. M. (1997). *Talking about leaving: Why undergraduates leave the sciences* (Vol. 12). Boulder, CO: Westview Press.

Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves student performance on in-class concept questions. *Science*, *323*(5910), 122-124.

Solorzano, D. (1993). *The road to the doctorate for California' s Chicanas and Chicanos: A study of Ford Foundation minority fellows*. Berkeley, CA: The California Policy Seminar.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American psychologist*, *52*(6), 613.

Steiner, J. F., Lanphear, B. P., Curtis, P., & Vu, K. O. (2002). Indicators of early research productivity among primary care fellows. *Journal of General Internal Medicine*, *17*(11), 854-860.

Tenenbaum, L.. S., Anderson, M. K., Jett, M., & Yourick, D. L. (2014). An Innovative Near-Peer Mentoring Model for Undergraduate and Secondary Students: STEM Focus. *Innovative Higher Education*, *39*(5), 375-385.

Thiry, H., Laursen, S. L., & Hunter, A-B. (2011). What experiences help students become scientists?: A comparative study of research and other sources of personal and professional gains for STEM undergraduates. *The Journal of Higher Education*, *82*(4), 357-388.

Thoman, D. B., Brown, E.. R., Mason, A. Z., Harmsen, A. G., & Smith, J. L. (2014). The role of altruistic values in motivating underrepresented minority students for biomedicine. *BioScience, 65,* 183-188.

Trujillo, G., &Tanner, K. D. (2014). Considering the role of affect in learning: Monitoring student's self-efficacy, sense of belonging, and science identity. *CBE Life Science Education, 13*, 6-15.

Umanzor, C. (2011). Experiences of women of color in biology. Master's Thesis. San Francisco, CA: San Francisco State University.

Wingard, D. L., Garman, K. A., & Reznik, V. (2004). Facilitating faculty success: Outcomes and cost benefit of the UCSD National Center of Leadership in Academic Medicine. *Academic Medicine*, *79*(10), S9-S11.

Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, *331*(6023), 1447-1451.

Appendix A – Mentor and Mentee Profiles for BUMP and the Research Skills Course

	Number of mentors	Mentors identified as Female / URM	Mentors retained through program	Number of mentees	Mentees identified as Female / URM	Mentees retained through program
BUMP 2012 – 2013	4	4	4	16	12	15
BUMP 2013 – 2014* (Fall semester only)	5	5	5	23	16	23
Research Skills Course (Fall 2012)	5	5	5	15	10	14
Research Skills Course (Fall 2013)	8	7	8	19	14	18
Research Skills Course (Fall 2014)	6	6	6	16	9	15

Statement	Theme
In terms of my professional life, which at this point in my life I consider to be my work in a research lab on campus, it has helped me develop my communication skills. It has been difficult for me to explain the research I do to people who are not in my field; field-specific terms and jargon may be the easiest way to explain what I am researching, but it means nothing to anyone else. One activity I do with my mentees is that I have them shadow me in lab as I do my daily routine of checking cultures. I even have them do it as well, so that they can experience what is like in a lab. They ask me numerous questions, and I try to explain them to the best of my ability. At first, it was really hard for them to understand what I did. It took me awhile to realize that it wasn't just that they didn't understand me, but it was equally my fault in that I was not conveying the research in an effective manner. From this I learned to be patient and to use my creativity in order to answer their questions. I would use analogies to explain the research, and in the end they all could understand at least where I was coming from.	*Bolstering Science Identity*
The BUMP Program has helped me apply the way I work with my mentees to the way I work with people in my other duties.	*Building Self-efficacy*
I find it a little challenging to guide group conversations and to be in a leadership position with my mentees because I am naturally more introverted. I am trying to learn to adapt to this new teaching style. I took a year and a half off from school after graduation so I feel like I am just learning how to be a student again. It's a little out of my comfort zone but I hope that it comes more naturally to me in the future.	*Not ready for the role of mentor*
...I didn't feel like I was on high enough level to be mentoring them. I'm finishing my second year of graduate school- BUT I just finished undergrad school in spring of 2006 and I felt that they were not far behind me.	*Not ready for the role of mentor*
At first, it was scary to meet my group. I was in their position not so long ago, so I feel like their equal. It's weird to be in charge.	*Not ready for the role of mentor*
Mentoring young students has been challenging to me so far for multiple reasons. One of these is that I am not sure what they want to get out of having a mentor and I am not sure what exactly I have to offer them, so I often have trouble deciding what to talk to them about.	*Not ready for the role of mentor*
When I asked myself what I could have done better to manage this situation, I had no answers. As a mentor, I asked questions and challenged my mentees, while I provided guidance and encouragement. I was ensured several times by my other two mentees that I was a great mentor, and that they were happy with my mentoring. They always asked me for help when they needed it, and I always gave them the time and respect they deserved from me.	*Cultivating meaningful relationships*

Many different thought went through my head but this nervousness subdued when I found out my group would have two mentors. I thought that the responsibilities would be divided and we could help the mentee better. This was not the case as time went on I found out that it is fully my responsibility as much it is hers. We both had to build a relationship with each student and help them individually as well as in a group setting.	*Cultivating meaningful relationships*
I wanted to be able to help them with anything and I wasn't sure if I would have enough time to dedicate towards them. Basically, I was nervous because I didn't want to let them down, and because I didn't want them to regret that they chose me and not another graduate student.	*Cultivating meaningful relationships*
I really make a conscious effort to make sure that both mentees feel heard. If [student A] volunteers her opinion on a class discussion topic I make sure that I ask [student B] what she thinks. I feel like [student B] is a little more quiet and introverted than [student A] so I make sure that she feels heard too. I really enjoy working with both of them.	*Cultivating meaningful relationships*
I learned a lot about myself and about my mentees. In the end, I felt I learned so much from them too. They even mentored me in the end. I'll miss each of them. I hope they keep me updated on their lives and I hope to see them again in the future...	*Cultivating meaningful relationships*
One of the most significant things I learned about research mentoring is that it takes work from both sides, mentor and mentee, in order to have a successful relationship.	*Cultivating meaningful relationships*