Summary of Research and Practical Findings from the Annual NIGMS Efficacy of Interventions Conference to Accelerate Research to Practice

San Diego, California
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Diversity of researchers in the biomedical sciences is of national concern. While intervention programs designed to encourage underrepresented minority (URM) students to pursue scientific careers have been in place for more than 30 years, an emerging body of research in the social and behavioral sciences is showing the efficacy of the programs and uncovering the mechanisms of the success. Since 2005, the National Institute of General Medical Science (NIGMS) and its Division of Training, Workforce Development and Diversity (TWD; formerly the Division of Minority Opportunities in Research) has made annual awards under the "Research to Understand and Inform Interventions that Promote Research Careers" program. This funding mechanism was established specifically to "support research that will test assumptions regarding existing or potential interventions that are intended to increase the preparedness for careers in biomedical research, with a particular interest in those interventions specifically designed to increase the number of underrepresented minority students entering careers in biomedical and behavioral research."

In August 2014, representatives from these funded research projects came together to summarize their findings at an annual grantee's conference. The research activities are unified in their focus on understanding and promoting a diversified biomedical workforce, and projects focused on a range of issues, programs, and approaches. This paper synthesizes the content of the NIGMS Efficacy of Interventions Conference to Accelerate Research to Practice held in San Diego, California on August 14-15, 2014.

Conference Agenda and Goals

The Research on Interventions Conference began with opening remarks by Drs. Mica Estrada from the University of California, San Francisco; Wesley Schultz from California State University, San Marcos; and Dr. Michael Sesma from the National Institutes of Health (NIH). Dr. Clif Poodry, of the Howard Hughes Medical Institute, gave a brief introductory talk in which he described his experience with this funding mechanism and the types of questions that remain for researcher and practitioners.

The conference format included each of the 30 NIH-funded project teams providing a 10-minute symposium-style presentation describing findings from the past year, followed by 5 minutes of questions and answers. At the conclusion of a session, in which 5-6 presenters spoke, each speaker hosted a 20 minute round table discussion in which more in-depth questions could be asked. After presentations by all project teams, Dr. Poodry provided comments and suggestions on the topics presented and discussed. Dr. Sesma made closing remarks, including information regarding the suspension of funding through this particular mechanism in 2015 and recommendations on alternative approaches for funding intervention research through NIH. An afternoon facilitated discussion of key questions followed in which participants, in small groups, identified lessons learned and implications for policy and practice. Drs. Estrada and Schultz closed the meeting (see full agenda in Appendix A).

Overview of White Paper

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Defining "Success"

Based on previous year's discussions on the topic, the metric of successful interventions utilized in this meeting was increasing student persistence such that underrepresented minority (URM) participants are more likely to *graduate with a science degree, enroll in science courses, apply to graduate school including masters, doctoral, and medical programs, work as a biomedical scientist, have peer reviewed publications, and serve as a principal investigator on R01 grants*. The second most frequently used category of success was psychological outcomes, most notably scientific self-efficacy (i.e., perceived ability to conduct science related activities). Overall there was wide agreement that students should *do* something as a consequence of their involvement in a funded training program, and these actions should lead to continued involvement and accomplishments in biomedical fields.

In addition to student biomedical career engagement, attendees listed more global characteristics of successful science training programs which included a) sustainability (meaning that the program is sustainable across years); b) potential for intervention to be scaled-up, or applied in other institutions/settings; c) cost effectiveness, and d) demonstration that interventions are achieving pre-determined outcomes (defined by the objectives of the intervention compared to a control or comparison group).

Convergent and Replicated Research Findings

Across the 30 funded project presentations, there is overwhelming evidence that science training programs result in students pursuing biomedical science careers at higher rates than those who do not participate in training programs. While early research was primarily anecdotal in nature, this RFA is providing the support necessary to conduct rigorous research with comparison groups and longitudinal tracking that demonstrates the efficacy of these programs (see Appendices B, C and D for a full list of the funded research projects and their research questions). **The clear conclusion from these studies is that science training programs designed to encourage URM students to stay in science *do* work.** In addition, the research programs represented at the conference are beginning to provide models for *why* these programs work. Because research projects are at different stages of implementation, we are not providing here a comprehensive review of all the projects. Instead, this section of the report highlights the promising and convergent findings that emerged in this latest meeting, categorized into three subsections: (A) *program components*, (B) *psychological processes*, and the emerging (C) *culture and context*. We describe both convergent findings from previous years and how these results have been extended in the past year.

Caveat. These categories have permeable boundaries and many research programs span across multiple areas. A number of the research programs represented at the conference reported several years of longitudinal data and provided evidence of program components and the psychological processes underlying their success at retaining minority scientists. In addition, some research programs have identified multiple mediators. We acknowledge the complexity and richness of the research findings presented at this conference and highlight the most consistent findings in this section.

A. Program Components

Programs for URM students offer a variety of services, experiences, and support. In addition, programs differ in duration, program sites, and participant demographic pools. However, the majority of the programs being studied include at least one of three common elements: (a) research experience, and (b) faculty mentoring (both training mentors and training students), and (c) engaging environments. Because of the convergence of results in these areas, we draw common conclusions based on empirical evidence regarding these program component impacts.

1. Research Experience. Across a range of age groups, program designs, intensity and duration, findings show that research experience is integral to the development and sustaining of interests in scientific careers among students. Research experiences under investigation occurred at various points in students' academic careers, including high school summer programs, undergraduate (UG) summer experiences, multi-semester UG research experience, post-baccalaureate research programs, fellowships, and elective research opportunities in medical school. Program and national research results repeatedly show that research participation significantly improves STEM bachelor's degree recipients' probability of enrolling in STEM graduate and professional programs. However, high school research experience alone was not found to strongly predict MD/PhD enrollment (where as UG research or HS/UG research was). Characteristics of successful research experiences have been discussed and are being studied in a variety of ways:

- Authenticity. Research experience in which the outcomes are not predictable, the skill set to run the experiment requires consequential decision-making, and the results are meaningful, increase the effectiveness of the intervention activity.

- Mastery opportunity and resilience. Qualitative interviews have repeatedly shown that students describe the experience of successfully completing a research activity as key to solidifying their interest in scientific

careers. A newly funded project will be investigating how opportunity for self-regulation also might be an important characteristic of research experiences.

- Ownership. While the term "ownership" was never explicitly defined during the meeting, there was convergent evidence that when students are able to publically communicate their findings to a larger community, either in the form of a poster, paper or oral presentation, this contributes to increasing commitment to a biomedical career. This is consistent with social psychological research showing that behavioral engagement can impact attitudes and definitions of self.

Finally, several studies this year reported on how research experiences during graduate school or post-graduate was predictive of persistence into faculty positions and longer-term retention. Thus, the positive impact of engaging in research experience appears to be robust across the pipeline.

2. Faculty mentoring/coaching. Mentoring is the second core component of many intervention programs and the focus of several research programs at the meeting. There was discussion among grantees that although numerous findings show that mentorship is related to persistence and commitment to a biomedical science career, it is not as strong a predictor of URM science students' success, and mentorship is often provided as part of a student's research experience, it is difficult to disentangle these two effects. For this reason, studies of mentorship are becoming more nuanced. One evolving measure of mentor effectiveness assesses to what extent mentors provide (1) mastery of technical and disciplinary knowledge in field and (2) mastery of tacit skills needed to craft career that fits one's needs and wants. Results show that mentor effectiveness contributes to student skill/knowledge development, which increases confidence and results in higher retention in PhD/MD careers.

One study examined how mentorship contributes towards the development of scientific communication self-efficacy. Their results showed that members of URM groups did not differ from other groups in perceptions of mentoring attention and quality. However, mentorship practice did fully mediate the relationship between first generation status and science communication self-efficacy-speaking, and partially mediated the relationship between academic rank and science communication self-efficacy-writing.

Institutional level research reported at the conference showed that universities that provide strong faculty support and mentorship are more likely to positively affect students' STEM identity and intentions to enroll in a STEM graduate program. Results also showed that the impacts are greater for URM students' STEM identity development. The benefits of mentorship are significant, even when accounting for the types of students likely to receive and seek out mentors.

Some studies are showing that mentor-protégé expectations are not always complementary. For instance, while URM protégés strongly believe that mentors should directly address diversity issues with them, fewer mentors agreed. Future research will focus on how mentor cultural awareness and mentor- mentee alignment contributes towards research self-efficacy.

Mentorship, in the form of adult encouragement, was found to be related to student endorsement of the subjective norm to pursue a college education, which was in turn related to intentions to pursue science careers following high school. Other research focusing on participation in academics where students are "coached," showed that participation resulted in increases student's beliefs that a science career was achievable. Qualitative results show that coaches being role models and providing a safe place were related to program success.

Evidence that URM and non-URM students are having different mentorship experiences also emerged from the research reported at the conference. In one study, surveys with Harvard Medical School alumni found that when asked if mentor(s) encouraged them to go into research as a career, 44% of URMs strongly or somewhat agreed, whereas this was true for 62% of non-URMs.

And finally, a useful new measure has been developed, the Attributes of Mentor Scale (AMS), which was shown to quantify mentor attributes that contribute to their protégés' career success.

3. Engaging Environments. Research and findings regarding supportive environments is an emerging area of study. Results reported at the conference showed that targeted interventions can be effective in retaining minority students' interest and persistence in biomedical careers. These interventions create a type of "inoculation effect" that prevents loss of interest among students already pursuing a scientific degree.

Utility-value interventions. Research programs are building greater knowledge about how valuing science relates to the persistence of URM scientists. For example, one study randomly assigned biology undergraduates to focus on the relevance and utility value of their biology course material (or not) in course assignments, and found that this improved course grades in a foundational course for the biomedical sciences. The biggest positive shifts occurred for first-generation URM students, who typically come into introductory biology with lower GPA, weaker biology backgrounds, and greater motivation and desire to give back to their community.

Belonging. Increasing the sense of belonging among women and minorities in the sciences was a theme that ran through many of the research projects. First generation majority and minority students report having more uncertainty about belonging in the sciences. One study found that a values affirmation intervention (in which students reflect on their personal values) promoted belonging, performance and persistence in biology. Another study found that it was important to students to have a "safe space" in which they could discuss the academic challenges they face.

Emerging research is examining URM and women who select labs led by persons of similar (homophilic) gender and race backgrounds, compared to women and URM students who select based on instrumental attraction. Preliminary findings show that while students do partition to homophilic labs by URM status and gender, women partition into "better" male labs and URM students partition into "better" non-URM labs (non homophilic). What this means is that for majority students (male non-URMs) the same lab can provide homophilic and instrumental alignment. But for URMs and women, they have to affiliate with several labs or faculty members to get both of these needs met.

Professional connecting. Findings are advancing regarding the concept of "reach," which refers to the amount of collaboration and co-authorship a student or faculty person has at any one time. Research presented at the conference showed that among Harvard Medical School faculty, those with greater reach are more likely to attain academic and professional milestones and are less likely to become a statistic of attrition. Looking at what is impacting "reach," it was found that (a) homophily exists in the coauthor networks of faculty, (b) network composition and strength of connections are related to discipline demographic composition, (c) representation of senior faculty is higher within the networks of women and full time instructors compared to men and higher faculty ranks, and (d) senior faculty compared to junior faculty tend to be more inclusive in terms of coauthoring with women and API, but there are no rank differences in coauthoring with URMs.

Creativity. Providing an intervention in which students create videos that reflect why they value research, spreading the video and then collecting data to show the impact of the video among schoolmates has been shown to effectively sustain interest in research careers and increase interest among those without initial interest.

B. Psychological Processes

In addition to looking at the effectiveness of specific intervention components, research presented at the conference sought to explain "why" a particular intervention has an impact on retention, persistence, and career choice, rather

than "if" it has an impact. Building upon the previous years' research, a number of the research groups presented evidence that three psychological mediators in particular are related to persistence and retention: self-efficacy, scientific identity (or identity as a scientist), and stereotype threat. In addition, we provide some description of current research on value (of science).

1. Self-efficacy. Self-efficacy is an individual's belief that s/he can perform well at a particular task or in a particular domain – such as science. Science self-efficacy continues to be a theme across several research programs, as an outcome, a predictor of scientific identity, and a mediator of persistence in the sciences. There was converging evidence that self-efficacy is a necessary, but not necessarily determining, component for minority persistence in the biomedical sciences.

This year there were several studies that reported on how efficacy builds in the context of minority training programs. Specifically, research showed that past successes, modeling, verbal persuasion and emotional awareness were related to increasing science self-efficacy.

A number of training programs were shown to have an impact on science self-efficacy, which in turn is related to persistence. Students working in a collaborative learning model was shown to increase scientific research self-efficacy and leadership/teamwork self-efficacy.

Looking at institutional trends, URMs at Harvard Medical School who completed an online survey report lower self-efficacy than non-URMs.

A specific form of self-efficacy found to be germane to sustained involvement in biomedical science careers is scientific communication (written and oral) self-efficacy (SCSE). Higher self-efficacy in scientific communication (at the graduate and postdoctoral levels) was found to be related to increased interest in performing such tasks as writing manuscripts and giving oral presentations, as well as to positive career outcome expectations, which in turn predicted intention to remain in research careers. When controlling for primary language, SCSE was not significantly related to URM status, speaking of a lower-prestige dialect or family-or-origin economic status. However, SCSE was significantly related to primary language, gender, academic rank, and parent's educational level.

2. Identity as a Scientist. Identity as a scientist refers to the extent to which individuals see themselves as scientists. In past years, identity as a scientist emerged from many of the grantees' research programs as a strong, direct predictor of persistence in the science pipeline. For example, as URM students become more highly identified within their biomedical science domain, they increase their chances of persisting in their major.

Students in the Collaborative Learning Model, as part of the BRAIN study, showed an increase scientific identity and intentions to persist in neuroscience careers. Another study on the PREP program showed that a critical outcome of their intervention was helping students develop a readiness to present self (i.e., identity). They define "readiness" as occurring when a student sees themselves and is seen as accepted by others as a grad student and/or scientist.

Scientific Self-Efficacy and Identity as a Scientist. In addition to studies of scientific self-efficacy and identity as a scientist, a number of research teams have in the past presented data on the relation between efficacy and identity. Longitudinal data is showing that science self-efficacy contributes towards building identity as a scientist, which is then related to commitment to a science career. Other research similarly that efficacy drops out as a predictor of persistence when science identity is added into the equation. Whereas self-efficacy is necessary for students to persist in science education, the development of scientific identity seems critical to later science career choice.

3. Stereotype Threat. Stereotype threat is the experience of anxiety or discomfort a person feels in a situation in which he or she has the potential to confirm a negative stereotype regarding his or her social group. There is converging evidence that minorities in the biomedical sciences are experiencing stereotype threat and that it is hampering persistence.

Harvard medical alumni survey showed that 29% (strongly/somewhat agree) of URMs reported that their performance was being judged more closely than others, whereas only 11% of non-URM's gave the same response. Similarly, they found that 36% of URMs (strongly/somewhat agree) felt as if their performance was being judged as a member of the group to which they belong as opposed to being judged as an individual. Together, this indicated that URM respondents report higher experiences of stereotype threat than non-URMs.

In a study of over 1000 participants who came for 4 different intervention cohorts across four years, results showed that while women with greater gender rejection sensitivity are more likely to experience stereotype threat; this relationship is mediated by the campus climate. These findings highlight the importance of creating and maintaining a non-threatening campus climate and cultivating an environment of belonging and acceptance.

The study of stereotype threat has become more nuanced as projects differentiated between types of stereotype threat based on the perceived reference group of the threat. Self as threat and group as threat were identified as qualitatively different forms of stereotype threat that are responsive to different interventions. Specifically, role models reduced *group*-as-target stereotype threats and self-affirmations reduced *self*-as-target stereotype threats.

4. Values. Over the years there has been emerging evidence that valuing science is an important predictor of perseverance in the sciences. Several studies showed that interventions that increase valuing of science are more likely to result in maintaining interest in science careers both for undergraduates and graduate science students. Specifically results are showing that when scientific goals are connected to communal goals, future motivation and positivity towards science careers increases. For example, 86% of URMs indicated that they found it extremely/somewhat important that "My career should allow me to serve the needs of needy and underprivileged people" compared with 66% of non –URMs at a highly competitive university. Another study on culturally connected communal goals with undergraduate Latino and Native American populations working in biomedical research labs showed that an intervention that highlighted the altruistic goals achieved by conducting research increased greater psychological involvement in research lab and science career interest for URM. These effects were larger for URM students compared to non-URM students. They conclude that (a) perceiving research as fulfilling communal goals positively predicts biomedical career interest and (b) asking students to add communal connections to their research descriptions enhances research lab involvement.

Finally, a study of Native Americans, White and Asian undergraduate students drew similar conclusions, with results showing that those students who were very involved in their tribes and possessed high ethnic identity were less likely to see fields related to math, science, and medicine as benefitting their communities. The lack of perceived benefit was given as the explanation for why these types of careers were not being pursued even though students found them to be interesting.

5. Goal orientation. Goal orientation theory suggests that a students' goal orientation characterizes their motivational path. Mastery goal orientation (i.e., which is defined by one being motivated to achieve in order to personally excel in a task or skill) has repeated been found to related to academic persistence (as opposed to being motivated to achieve to avoid failure or to please other people). In a recent study students who participated in our early undergraduate pharmacology enrichment program were more likely to endorse mastery goals (along with higher levels of self-efficacy and value) and the increase in these three psychological mediators were associated with increased STEM course-taking and intentions to purse research careers.

C. Culture and Context

Different value sets may stem from different cultural backgrounds. Current research was presented that explicitly sought to understand how student cultures and educational context (outside of the science training context) impacts science interests and perseverance.

One study examined a multiple-worlds model using qualitative methodologies. This research identified three worlds for urban Hispanic high school students (family, peers, and media). And surprisingly, they found that familial support for this urban Hispanic population appeared to have more influence on career decisions than peers or media.

Using a similar methodology, a diverse group of doctoral students were interviewed and results indicated that career decisions are being made based on the possibility that a work-life balance can be achieved – making highly competitive research universities less attractive. Interestingly, the results also indicated no significant gender patterns in the preference for work-life balance. Instead, URM doctoral students placed emphasis on being happy.

Emerging research in this area includes an evaluation of the effects of a URM student-led social media campaign that was designed to shift perceptions of science (and its culture) on interest in a clinical research career among friends of students in a pipeline clinical research program.

Promising Topics and Methods

In previous years there was robust discussions about how to move forward the theory, methodology, practice and policy regarding why interventions succeed or fail to increase URM persistence. The importance of this funding mechanism to increasing the knowledge base cannot be overemphasized. In the 2014 meeting, there was mostly informal discussion of these topics. Therefore, the summary of conclusions accumulated across the past 10 years from this yearly meeting is largely restated from earlier reports, with minor updates from the 2014 conference.

A. Theoretical Approaches

There are several theoretical approaches and constructs discussed that hold promise for future research.

Participant attributes. Students placed in the same program respond differently. In some cases, program participants respond differently to similar program experiences. Several attributes that are beginning to be examined, but that warrant more research include the following:

- *Cultural Capital*. A number of demographic variables are starting to be identified and tested for their impact on success. For example, gender and status as a first generation have been shown to be important factors in understanding participants' experiences and perceptions of biomedical careers. There was a recommendation to address the issue of being a double URM, such as being an African American *and* a woman. This experience of having more than one URM identity is currently not being addressed in this initiative.

- *Individual Differences*. A number of individual differences variables are beginning to be identified as potentially important facilitators or inhibitors of URM persistence. These individual differences include preparedness and resilience to stressors, motivational profiles, unconscious biases, joy in work, and personal theories of intelligence.

Contextual attributes. There is evidence that regardless of individual differences, some contexts have positive and meaningful impacts on URM science career persistence. As described earlier, research training and mentorship

have significant impact on participants. Additional contextual issues that attendees noted as needing additional research include the following interpersonal level attributes:

- *Climate*. Any context or environment can be described in terms of "warmth" or "chilliness." Grantees agreed that different "micro-climates," such as lab and department climates, need to be explored. In addition to perceptions of warmth, these micro-climates may vary in term of their supportiveness or "culture of care".

- *Classroom Structure*. A number of grantees identified classroom teaching practices in science courses as a potential facilitator or barrier to developing interest in the sciences. Questions surround the role of innovative teaching methods and the teaching culture (e.g., lecture only, competitive) in persistence in biomedical disciplines.

Additional contextual issues emerging in the research also include the following at the dyadic/ relational level between mentors and mentees.

- *Cultural competencies*. Faculty mentors and other influential people vary in their ability to understand the cultural background and experiences of URM students. The type and level of understanding may impact the quality of interpersonal communication, non-verbal behaviors, expressions of respect, use of humor, the building of rapport, and what is deemed as appropriate behavior.

Additional contextual issues emerging in the research include the following institutional level contextual attributes:

- *Climate*. On a macro level, researchers could explore how scientific climates are changing at different institutions and how policy changes impacting institutional contexts relate to individual experience. There is also a particular interest in capturing how potential differences in the cultures of selective vs. less selective institutions influence participant perceptions. Further, there is interest in understanding the impact of Historically Black Colleges and Universities (HBCU) and Hispanic Serving Institutions (HIS) culture on student perceptions and persistence. Future research can examine if climate is related to participant experience of belonging in science and foster the development of science identity, efficacy and persistence.

- *Biomedical Science Differentiation.* Within a single institution and across different institutions, there may be important differences in the norms, practices, and culture exhibited in science, technology, engineering, and mathematics disciplines. Each of these disciplines may represent unique contexts that differently influence participant experiences and perceptions. Therefore, we need to begin to differentiate between these contexts.

B. Methodological Approaches

As in all areas of scientific inquiry, excellence in research design and rigorous methods for collecting data are critical for developing new knowledge. The characteristics that were described as being vital to the endeavor include:

At the Student Level

- Tracking participants over time (i.e., using traditional longitudinal, and accelerated longitudinal methods) to assess both short-term and long-term impacts of program elements across the academic pipeline.

- Collecting data from similar cohorts of students who do not participate in the program as a comparison or control group.
- Utilization of objective outcome measures such as grades, knowledge assessments, degree conferment and discipline of study.
- In-depth case studies or focus groups with program participants to track experiences at time of participation and shortly after (i.e., prospective studies).
- Move beyond linear models and explore decision points at which time individuals and attributes of the context lead to binary (yes/no) decision switches.
- When possible, utilize random assignment to intervention groups.
- Designing randomized controlled interventions that compare the impacts of long versus brief engagement in program elements.

At the Dyadic Level

- In-depth interviews with mentor-mentee dyads. Focus on how relationship quality influences mentee career decisions and advancement.

At the Mentor or College Level

- Use of cluster randomized controlled interventions targeting faculty and graduate student mentors. These interventions measure the effect of the intervention on URM students that are clustered within mentors that experienced or did not experience the intervention.

There was a widespread belief among conference attendees that creative multi-disciplinary approaches and sophisticated analysis strategies are necessary to truly understand and test program impacts on short-term and long-term biomedical career persistence.

C. Implications for Practice

There was much discussion about how best to use the information that we have gained thus far to impact programs currently being run. Any decision to apply or modify training techniques should be informed by research evidence.

Interventions that program directors might consider now

- Intentional development of authentic research experiences for program participants.
- Increased attention to how program elements promote scientific efficacy, identity and values, and reduce stereotype threat.
- Attention to training mentors/coaches to provide warmth, social support, instrumental support, and sufficient reward for curiosity and discovery to program participants.
- Cultural competency training
    - Encourage the conversation about culture/race with the proper support of professionals
    - Develop theory-driven, culturally appropriate tools that will educate program directors about ongoing societal barriers and processes that URM students/faculty encounter every day

- Actively measuring success and why it occurs
    - Program directors to include more metrics to understand their students
    - Require social scientist on evaluation team and/or use standardized evaluation instruments across programs (don't develop your own, but use those already in the literature)
    - Increase project manager awareness of person/environment fit on the trainee
    - Develop network for directors to share the best practices

- Replicate or adapt effective programs for new contexts and measure outcomes

Conclusion

In closing, grantees continued to wholeheartedly agree that the programs of research in the "Research to Understand and Inform Interventions that Promote Research Careers" RFA are making inroads into understanding the elements of minority training programs in the biomedical sciences and the psychological and situational mechanisms driving them. In addition, there was general agreement that the questions being asked are important and relevant to practice. The research currently being conducted is new, theoretically sound, methodologically rigorous, and immediately useful. Future conferences will offer opportunity to continue to identify the converging research evidence that will inform and refine program implementation.

APPENDIX A: CONFRENCE AGENDA

Annual Interventions Conference 2014

Thursday, August 14, 2014

6:30-8:00$_{AM}$ | Breakfast Buffet in the Britannia/Cambria Foyer

7:00-8:00$_{AM}$ | Registration Table Open

8:00-8:15$_{AM}$ | *Introductions and Goals for the Meeting*

Mica Estrada, University of California, San Francisco

Michael Sesma, Chief of the Postdoctoral Training Branch in the Division of Training, Workforce Development, and Diversity at the National Institute of General Medical Sciences

Wesley Schultz, California State University, San Marcos

8:15-8:30$_{AM}$ | Practitioner Perspective Part 1

Clifton Poodry, Senior Fellow in Science Education at Howard Hughes Medical Institute

8:30 -10:00$_{AM}$ | *Symposium 1*

|8:30-8:45| **Crystal Park and Michelle Williams**, University of Connecticut, Self-regulation skills as predictors of URM student success biomedical research

|8:45-9:00| **Joan Reede,** Harvard Medical School, A systems approach to advancing diversity in academic medicine: A focus on network connections

|9:00-9:15| **Vivian Lewis, Jennifer LaGuardia, Daryl Sharp, Richard Ryan**, University of Rochester, Psychological need satisfaction in early career underrepresented minority academics: Implications for job satisfaction, burnout, and personal well-being

|9:15-9:30| **Vinnet Arora & David Meltzer**, University of Chicago, TEACH STRIVES: Spreading teen-recorded videos to engage schoolmates

|9:30-9:45| **Barbara Schneider,** Michigan State University, Pathways to biomedical careers: Enhancing the high school experience

|9:45-10:00| **Robin Taylor Wilson, Mark Kaelin, Wendy Huebner,** Pennsylvania State University, Early preparation and inspiration for careers in the biomedical sciences (EPIC)

10:00-10:15AM | *Coffee Break*

10:15-10:40AM | *Roundtable Discussion*

10: 45-12:00PM | *Symposium 2*

|*10:45-11:00*| **Donna Jeffe & Dorothy Andriole,** Washington University, *Promoting research careers among underrepresented minority physicians (R01 GM085350)*

|*11:00-11:15*| **Ed Krupat**, Harvard Medical School, Minority physicians and research careers: Applying the Theory of Reasoned Action

|*11:15-11:30*| **Monica Gaughan & Gerardo Chowell-Puente,** University of Georgia, Using the scientific CV to study the effects of interventions on research careers

|11:30-11:45| **Bradley O. Boekeloo & Stephanie Timmons-Brown,** University of Maryland, Climbing up and reaching back: Ladder of support for research careers in biomedical and behavioral science

|*11:45-12:00*| **Jessi L. Smith,** Montana State University & **Dustin B. Thoman**, California State University, Long Beach, Culturally connected communal goals: Latino and Native Americans in biomedicine

12:00-12:25PM | *Roundtable Discussion*

12:30-1:30PM | *Lunch at Sunset Terrace*

1:30-2:45PM | *Symposium 3*

|1:30-1:45| **Lisa Linnenbrink-Garcia, Rochelle Schwartz-Bloom & Tony Perez**, Duke University, Self-generated research experiences to support biomedical/behavioral research careers

|1:45-2:00| **Judith Harackiewicz & Janet Hyde,** University of Wisconsin, Promoting motivation for underrepresented groups in undergraduate biology courses

|2:00-2:15| **Larry V. Hedges**, Northwestern University, Why do research prizes have effects on minorities' biomedical research careers?

|2:15-2:30| **Rick McGee, Simon Williams, Bhoomi Thakore, Veronica Womack and Letitia Onyango**, Northwestern University, The Academy for future science faculty Diversity through theory-driven coaching

|2:30-2:45| **Lori Anderson Snyder, Paul Spicer & Joy Pendley,** University of Oklahoma, Social Cognitive Influences on Scientific Research Careers among American Indians

2:45-3:00PM | *Coffee Break*

3:00-3:25PM | *Roundtable Discussion*

3:30-4:45PM | **Symposium 4**

|3:30-3:45| **Robyn Gershon, Elizabeth Ozer, Mitchell Feldman, Mica Estrada, Kiersten Robertson, Linda Gregor,** University of California, San Francisco, BRIDGE Biomedical research career IDentification in graduate education
|3:45-4:00| **Jenessa Shapiro,** University of California, Los Angeles, Promoting women's interest in STEM careers by reducing stereotype threats
|4:00-4:15| **Carrie Jo Braden, Adelita Cantu & Janna Lesser,** University of Texas Health Science Center at San Antonio, MESA: Mechanisms for enhancing scholarly achievement
|4:15-4:30| **John Rodgers,** Baylor College of Medicine **& Michelle Hebl,** Rice University, Mentoring interactions in scientist development
|4:30-4:45| **Jorge A. Girotti, Alan Schwartz, Kendy Oláguez & Jessica Barnes**, University of Illinois at Chicago Research careers for Hispanic students: Testing the multiple worlds model

4:45-5:10PM | Roundtable Discussion

5:30-7:00PM | *Drink Reception at Sunset Terrace*
7:00PM | *Dinner at Sunset Terrace*

Friday, August 15, 2014

6:30-8:00AM | **Breakfast Buffet in the Britannia/Cambria Foyer**

8:00-9:30AM | *Symposium 5*

|8:00-8:15| **Kyle Frantz, Chris T. Goode, Shari L. Britner, Laura L. Carruth, Robert L. DeHaan, Melissa K. Demetrikopoulos, John. L. Pecore, & Brian A. Williams,** Georgia State University, Collaborative brain research for novice undergraduates

|8:15-8:30| **Bettina Casad,** California State Polytechnic University, Pomona, Effects of threatening environments on women's success in biomedical majors
|8:30-8:45| **Elise Lev & Lucille Sanzero Eller,** Rutgers University, Efficacy intervention to promote research careers
|8:45-9:00| **Robert Tai, Heather Wathington, Donna Jeffe & Dorothy Andriole,** University of Virginia, Washington University, Transitions in the education of minorities underrepresented in research
|9:00-9:15| **Phillip J. Bowman, Angela Ebreo & Deborah Carter,** University of Michigan, A mixed-method study of exemplary research opportunity interventions: Bridging theory-driven research and program innovation

9:15-9:40$_{AM}$ | **Roundtable Discussion**
9:45-10:00$_{AM}$ | *Coffee Break*

10:00-11:15$_{AM}$ | **Symposium 6**

|10:00-10:15| **Angela-Byars Winston & Christine Pfund,** University of Wisconsin, Madison, What matters in mentoring? Testing and measuring and mentor training intervention
|10:15-10:30| **Shine Chang & Carrie Cameron,** University of Texas MD Anderson Cancer Center, Improving retention of minority trainees: Mentoring in scientific communication skills
|10:30-10:45| **Sylvia Hurtado & Mitchell Chang,** University of California, Los Angeles, Broadening impact: Key factors that improve diversity in STEM research careers
|10:45-11:00| ***P. Wesley Schultz,*** *California State University, San Marcos* ***& Mica Estrada,*** *University of California, San Francisco, A national evaluation of the RISE program*
|11:00-11:15| ***Rick McGee, Robin Remich, Christine Wood, Adriana Brodyn & Patricia Campbell****, Northwestern University, Career decision-making of future minority biomedical science faculty*

11:15-11:40$_{AM}$ | **Roundtable Discussion**

11:45-12:00$_{pm}$ | Practitioner's Perspective Part 2

Clifton Poodry, Senior Fellow in Science Education at Howard Hughes Medical Institute

12:00-12:15$_{PM}$ | Concluding Comments on Annual Reports and Conference

Michael Sesma, Chief of the Postdoctoral Training Branch in the Division of Training, Workforce Development, and Diversity at the National Institute of General Medical Sciences

12:15-12:30$_{PM}$ | **Group Discussion: Facilitated by Mica Estrada, University of California, San Francisco: What have we contributed and what happens next?**

12:30-1:30$_{PM}$ | Lunch at Sunset Terrace (table discussions)

1:30-1:45$_{PM}$ | **Post-Discussion Debrief & Final Remarks**

P. Wesley Schultz, *California State University, San Marcos* **&** ***Mica Estrada,*** *University of California, San Francisco*

1:45$_{PM}$ | **Adjourn**

This conference was made possible by a R13 conference grant from NIGMS, and contributions from California State University San Marcos.

APPENDIX B: PRINCIPAL INVESTIGATORS & REPORT TITLE SUMMARY TABLE

Project PI(s)	PI Affiliation	Project	First Funded
Anderson Snyder, Lori; Spicer, Paul; & Pendley, Joy	University of Oklahoma	Social Cognitive Influences on Scientific Research Careers among American Indians	2013
Arora, Vineet & Meltzer, David	University of Chicago	TEACH STRIVES: Spreading Teen-Recorded Videos to Engage Schoolmates	2013
Boekeloo, Bradley & Timmons-Brown, Stephanie	University of Maryland	Climbing Up and Reaching Back: Ladder of Support for Research Careers in Biomedical and Behavioral Science	2010
Bowman, Philip; Ebreo, Angela & Carter, Deborah	University of Michigan	A Mixed-Method Study of Exemplary Research Opportunity Interventions: Bridging Theory-Driven Research with Program Innovation	2009
Braden, Carrie Jo; Lesser, Janna & Gonzales Cantu, Adelita	University of Texas Health Science Center, San Antonio	Mechanisms for Enhancing Scholarly Achievement (MESA)	2010
Byars-Winston, Angela & Pfund, Chrisitine	University of Wisconsin, Madison	What Matters in Mentoring? Testing and Measuring a Mentor Training Intervention	2010
Cassad, Bettina	California State Polytechnic University, Pomona	Effects of Threatening Environments on Women's Success in Biomedical Majors	2010
Chang, Shine & Cameron, Carrie	University of Texas M.D. Anderson Cancer Center	Improving Retention of Minority Trainees: Mentoring in Scientific Communication Skills	2009
Frantz, Kyle; Goode, Chris; Britner, Shari L.; Carruth, Laura L.; DeHaan, Robert L.; Demetrikopoulos , Melissa K.; Pecore, John L. & Williams, Brian A.	Georgia State University	Collaborative Brain Research for Novice Undergraduates	2008
Gaughan, Monica & Chowell-Puente, Gerardo	Arizona State University	Using the Scientific CV to Study the Effects of Interventions on Research Careers	2010
Gershon, Robyn; Ozer, Elizabeth, & Feldman,	University of California, San Francisco	Biomedical Research Career Identification in Graduate Education (BRIDGE)	2013

Project PI(s)	PI Affiliation	Project	First Funded
Mitchell			
Girotti, Jorge; Schwartz, Alan; Oláguez, Kendy & Barnes, Jessica	University of Illinois, at Chicago	Research careers for Hispanic students: Testing the multiple worlds model	2011
Harackiewicz, Judith & Hyde, Janet	University of Wisconsin, Madison	Promoting Motivation for Underrepresented Groups in Undergraduate Biology Courses	2012
Hedges, Larry	Northwestern University	Why Do Research Prizes Have Effects on Minorities Biomedical Research Careers?	2011
Hurtado, Sylvia, & Eagan, Kevin	University of California Los Angeles	Broadening Impact: Key Factors that Improve Diversity in STEM Research Careers	2004
Jeffe, Donna, & Andriole, Dorothy	Washington University, St. Louis	Promoting Research Careers among Underrepresented Minority Physicians	2008
Krupat, Edward	Harvard Medical School	Minority Physicians and Research Careers: Applying the Theory of Reasoned Action	2011
Lev, Elise & Sanzero Eller, Lucille	Rutgers University	Efficacy Intervention to Promote Research Careers	2008
Lewis, Vivian	University of Rochester	Psychological Need Satisfaction in Early Career Underrepresented Minority Academics: Implications for Job Satisfaction, Burnout, and Personal Well-being	2010
Linnenbrink-Garcia, Lisa; Schwartz-Bloom, Rochelle	Duke University, Michigan State University	Self-Generated Research Experiences to Support Biomedical/Behavioral Research Careers	2010
McGee, Richard	Northwestern University	The Academy for Future Science Faculty – Diversity through Theory-Driven Coaching	2011
McGee, Richard; Remich, Robin; Wood, Christine; Brodyn, Adriana & Campbell, Patricia	Northwestern University	Career Decision-Making of Future Minority Biomedical Scientists	2008
Reede, Joan Y.	Harvard Medical School	A Systems Approach to Advancing Diversity in Academic Medicine: A Focus on Network Connections	2010
Rodgers, John R. & Hebl, Michelle	Baylor College of Medicine & Rice University	Mentoring Interactions in Scientistic Development	2011
Schneider, Barbara	Michigan State University	Pathways to Biomedical Careers: Enhancing the High School Experience	2012
Schultz, Wesley &	California State University, San	A National Evaluation of the RISE Program	2005

Project PI(s)	PI Affiliation	Project	First Funded
Estrada, Mica	Marcos & University of California, San Francisco		
Shapiro, Jenessa R.	University of California, Los Angeles	Promoting Women's Interest in STEM Careers by Reducing Stereotype Threats	2012
Smith, Jessi L. & Thoman, Dustin B.	Montana State University & California State University, Long Beach	Culturally Connected Communal Goals: Latino and Native Americans in Biomedicine	2011
Tai, Robert; Wathington, Heather; Jeffe, Donna & Andriole, Dorothy	University of Virginia & Washington University	Transitions in the Education of Minorities Underrepresented in Research (TREMUR)	2010
Wilson, Robin Taylor; Kaelin, Mark & Huebner, Wendy	Pennsylvania State University	Early Preparation and Inspiration for Careers in the Biomedical Sciences (EPIC)	2013

APPENDIX C: PROGRAM RESEARCH QUESTIONS AND AIMS TABLE

Project PI(s)	Research Aims & Questions
Anderson Snyder, Lori; Spicer, Paul & Pendley, Joy	This project examines factors that facilitate and impede academic perseverance and career achievement among Native American students by tracking five cohorts of students to test a longitudinal model of Social Cognitive Career Theory and model changes in science interest and career goals over the undergraduate experience. Personal and contextual inputs, learning experiences, self-efficacy expectations, and outcome expectations will be examined as predictors of interest in, goals set, and actions taken to achieve behavioral and biomedical research careers. The project has four specific aims: 1. To use Social Cognitive Career Theory to model and determine the relative importance of factors that influence interests, goals, and actions expected to lead to successful behavioral and biomedical research careers among American Indian students. 2. To examine differences in important factors predicting success in academic perseverance and career attainment for American Indian behavioral and biomedical science majors versus American Indian non-science majors. 3. To examine change in efficacy, interests, and goals related to career achievement over the course of the undergraduate experience, and identify predictors of these changes. 4. To investigate the cultural and contextual factors that shape the pathways of American Indian students to the University.
Arora, Vineet & Meltzer, David	One promising solution to increase interest in clinical research careers among high achieving youth at a time when career decision making is easily influenced is through the spreading video messages crafted by youth for youth through social media. Therefore, the specific aims of this proposal are the following: 1. To engage high achieving minority youth enrolled in an intensive pipeline clinical research program in performing focus groups and surveys of their peers to characterize what types of messages would be most likely to motivate their peers to consider a career in clinical research 2. To engage high-achieving minority youth participating in a pipeline clinical research program in a social media campaign in which they will create a short video to promote interest in clinical research careers and spread it to their schoolmates 3. To evaluate the reach of social media campaign led by students in a pipeline clinical research program to spread a video they create to improve interest in clinical research careers 4. To evaluate the effects of a student-led social media campaign on interest in a clinical research career among the schoolmates of students in a pipeline clinical research program
Boekeloo, Bradley & Timmons-Brown, Stephanie	Research Aims: 1. Examine the characteristics associated with high achieving high school students' pursuit of health science. 2. Assess whether an EM condition is less likely than an EM+SPHM condition to facilitate pursuit of a health science career.
Bowman, Phillip	This project combined *archival* with *quasi-experimental, strengths-based assessment,* and *qualitative methods* to further clarify links between pivotal role strain and adaptation mechanisms and pipeline intervention efficacy. This *strengths-based project* fills gaps in our understanding of how "strong" faculty mentoring and program support in pipeline interventions combine with US strengths to buffer negative effects of systematic barriers that impede successful intervention outcomes. In practical terms, this strengths-based understanding can inform *innovative program support strategies* to

Project PI(s)	Research Aims & Questions
	augment core intervention activities. Beyond *direct effects*, strengths-based support strategies may also enhance intervention success by: 1. *Reducing* negative effects of US role barriers 2. *Reinforcing* the benefits of adaptive strengths that US bring to intervention settings. To promote *research-to-practice translation*, project researchers have begun to explore collaborations with exemplary intervention coordinators to experiment with innovative strengths-based support strategies (*mentoring, organizational, and social-cognitive)* to further improve intervention efficacy. In the long-term, this project will: 1. Develop a *Strength-based Assessment System* with high quality measures of US role strains, adaptive multilevel strengths, and social-cognitive mechanisms related to intervention success 2. Guide *research-to-practice innovation* including *strengths-based support strategies* within exemplary pipeline interventions during critical transitions (i.e. middle-to-high school, high school-to-college, community college-to-baccalaureate, undergraduate-to-graduate/professional, graduate school-to-scientific career).
Braden, Carrie Jo; Lesser, Janna & Cantu, Adelita	Research Aims: 1. Determine if there is a significant difference in proximal and distal outcomes between graduate students who participate in theMESA program and graduate students who do not participate in the program. 2. Determine the impact of goal setting and future visioning intervention strategies on Motivator Direction and Strength. 3. Assess the MESA Model antecedent variable, Motivator Strength & Direction, as a risk factor for increased exposure to Interpersonal Risks.
Byars-Winston, Angela & Pfund, Christine	Our primary goal is to develop, implement, and evaluate the effectiveness of research mentor training interventions in order to advance undergraduates' science pursuits, especially individuals from underrepresented minority groups. Specifically, we are working to identify causal mechanisms of research mentoring relationships, advance psychometrically sound measures of research mentoring relationships, and test a theoretically-based research mentor training intervention.
Cassad, Bettina	Research Aims: 1. Examine the role of math/science and gender identification in experiencing stereotype threat induced performance decrements 2. Testing how physiological, cognitive, and motivational mechanisms mediate stereotype threat 3. Testing individual difference variables that moderate the experience of threat or challenge in response to threatening intellectual environments.
Chang, Shine & Cameron, Carrie	Our objective is to determine which actionable factors contribute to success in SC skill acquisition, with the ultimate goal of improving retention of biomedical sciences trainees in career paths as independent investigators.
Frantz, Kyle; Goode, Chris; Britner, Shari L.; Carruth, Laura L.; DeHaan, Robert L.; Demetrikopoulos , Melissa K.; Pecore, John L.	This research aims to integrate quantitative and qualitative assessments to compare outcomes from the traditional Apprenticeship Model for undergraduate research to a Collaborative Learning Model, with the ultimate goal of integrating the Collaborative Learning Model into science curricula at institutions where research apprenticeships are not feasible for most students. Current objectives include "scaling up" to other types of colleges and universities, and consideration of data sharing possibilities.

Project PI(s)	Research Aims & Questions
& Williams, Brian A.	
Gaughan, Monica & Chowell-Puente, Gerardo	We develop and test the Policy-Academic-Career Outcome Trajectory Model to study how targeted and untargeted training programs affect the development of career trajectories and the achievement of scientific milestones among biomedical scientists. We collected administrative, survey, curriculum vitae, and biosketch data from over 500 PhD scientists who had been supported by the F31 doctoral support mechanism. These data are being used to construct longitudinal career histories that start in childhood, and extend to the current period. The specific overarching hypothesis is that targeted training interventions help to overcome prior disadvantage, leading to similar career outcomes between men and women and members of majority and minority racial and ethnic groups. Current work is focused on structuring the data to support survival analytic techniques focused on assessing career timing and velocity variables. Cross-sectional research on current career outcomes finds few differences between men and women or between members of minority and non-minority racial and ethnic groups
Gershon, Robyn; Ozer, Elizabeth & Feldman, Mitchell	The purpose of this study is to determine the effectiveness of a theory-driven, multi-modal intervention designed to increase self-efficacy, outcome expectations, scientific identity, and persistence in pursuing a science research career among URM and non-URM early stage doctoral students over a three-year period.
Girotti, Jorge; Schwartz, Alan; Oláguez, Kendy & Barnes, Jessica	Research Aims: 1) To describe and compare longitudinal trajectories of motivation to pursue biomedical/behavior science pathways among Hispanic students compared with students of other ethnicity at various Chicago high schools. 2) To examine parental knowledge and attitudes toward careers in biomedical/behavioral science research among Hispanic students, and describe associations between parental characteristics and student trajectories. 3) To examine social-network relationships between students' trajectories and those of their peers.
Harackiewicz, Judith & Hyde, Janet	Our primary objective is to promote performance and persistence for underrepresented ethnic minority (URM) and first-generation (FG) college students in introductory biology courses, which act as a gateway to successive courses and careers. Our project tests two brief writing interventions that have produced striking effects on student motivation and achievement in science classes. The values affirmation technique focuses on the student's personal values; the utility value intervention focuses on the value or usefulness of course content. Our goals are to: 1. Test the effectiveness of the values affirmation intervention and the utility value intervention in introductory biology classes for threatened groups (URM and FG) for the following outcomes: retention in the course, course performance, and interest in biology. 2. Test the two interventions in combination to determine whether they work additively or synergistically to promote motivation and performance in biology courses for threatened groups (URM and FG). In addition, we plan to test the long-term effects of both interventions on students' subsequent course-taking, choice of major, and career plans at graduation.
Hedges, Larry	Prizes are ubiquitous in the academic world and are generally believed to have strong effects on individuals who receive them and even on their colleagues who do not. Yet the precise mechanism by which prizes have effects is ambiguous. However, while prizes may have positive effects on winners, game theoretic analyses suggest that potential negative effects of discouraging the much larger number of losers could outweigh the positive effects on winners (e.g., when prizes are used to increase minority participation in biomedical scientific careers).

Project PI(s)	Research Aims & Questions
	This project's primary specific aim addresses the mechanism by which research prizes affect undergraduate minority students' probability of pursuing and completing graduate training in the biomedical sciences. By using data from individuals who were in prize competitions as long as 12 years earlier (than final data collection), this project will be able to examine effects on completion of graduate school and post-graduate school academic appointments in the course of the study. Beyond this primary specific aim, the project's objective is, first, to answer whether the effects on the prize winners of research prizes are primarily due to signaling (changing how the world sees the individual), changing the subjective probability of success in a biomedical science career (changing how the individual sees the world), or identity formation and intrinsic motivation (changing the individual). To answer this key question, the project must learn whether research prizes have causal effects on undergraduate students' probability of pursuing and completing graduate training in the biomedical sciences. The research is predicated on the assumption that research prizes have such an impact. These research questions are intended to validate that belief and to provide information about the magnitude of prize effects on career choice, identity formation, intrinsic motivation, and subjective probability of career success that might be practically useful. Ultimately, the project sees studying prizes as a particularly good way of studying mechanisms that produce effects on career choices, which may also help improve prize competitions as interventions and may help design more effective interventions of other types.
Hurtado, Sylvia & Eagan, Kevin	This project contributes to understanding how institutions can become more productive in increasing the number of STEM degrees among URM students by studying institutions and examining the faculty role related to teaching and training at the undergraduate and graduate levels. We also aim to study the contexts that surround interventions since successful interventions can actually result in broader institutional change. An important innovation of this project is that we focus on using large-scale data collection and analyses of populations of institutions (characteristics and outcomes), faculty (behaviors, teaching and training practices, career and work/life experiences), and students (background, aspirations, experiences), mixing and integrating levels to understand the dynamics of individuals in context. The large-scale data also provides comparison information about differences regarding particular types of institutions and groups of interest. Going forward, the 10-year follow-up of the 2004 entering student cohort will provide information with regard to graduate degree completion, workforce entry, and ambitions to pursue a research career as a scientist. The 2013-2014 HERI Faculty Survey will provide more information on STEM faculty behavior; institutional case studies will reveal how successful programs garner institution-wide support or lead to change via contagion or adaptation of essential components across the institution.
Jeffe, Donna, & Andriole, Dorothy	Our primary research objective is to identify factors amenable to intervention that are associated with physicians' academic medicine career trajectories and with physicians' receipt of individual NIH research funding awards. We are examining the career paths of physicians because physicians in academic medicine contribute to the biomedical research enterprise both directly, through their research activities as NIH-funded investigators, and indirectly, through their participation in the education of students in a wide range of health professions and graduate training programs and their service as role models and mentors for these students and trainees. Thus, an examination of factors associated with each of academic medicine career development and NIH-funding receipt will contribute to the knowledge about factors that broadly promote physician participation in the

Project PI(s)	Research Aims & Questions
	biomedical research enterprise.
Krupat, Edward	The primary objectives of this study are 1) to determine whether interest in a research career differs among URMM and non-URMM students and graduates of HMS; and 2) to determine whether the factors associated with a research career among URM and non-URM students are similar or different. This year we have completed data collection for the four cohorts of former students who were 15-16 years post-graduation when surveyed. Among the potential experiential and attitudinal factors measured in this survey are attitudes toward research; normative pressures to pursue research; experience of stereotype threat; mentoring, and self-efficacy. In addition we were interested in determining whether socio-economic background, as measured by father's education, and debt at graduation, were determining factors.
Lev, Elise & Sanzero, Lucille	The primary objective of the study is to increase protégés' clinical research self-efficacy.
Lewis, Vivian	According to Self-Determination Theory, humans have three basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; *Psychological Inquiry*, 11, 227–268; Ryan & Deci, 2000 *American Psychologist*, 55, 68–78). These three needs have been shown to be universal and important across contexts and across the lifespan, such that the more these needs are supported by important others (e.g., teachers, employers) the more people will thrive in their pursuits and experience optimal well-being (Ryan & Deci, 2000). As such, for protégés to flourish in academia it is critical for mentors to attend to and support each protégé's psychological needs within the work environment. Indeed, prior research has shown that the more students and work professionals feel that their needs are supported, the more they develop greater value for and interest in their school or work activities, the more actively, energetically, and persistently they engage in their goal pursuits in these domains, and the better they perform. The present study examines the extent to which psychological need support from personal mentors as well as the overall academic workplace environment across 1-year impacts job satisfaction, burnout, and personal well-being of academic protégés who belong to underrepresented minority groups.
Linnenbrink-Garcia, Lisa & Schwartz-Bloom, Rochelle	Research Aims: (1) Evaluate the effect of participating in the LEAP summer course on science-related motivational beliefs, achievement, and career-related beliefs/choices. (2) Evaluate the added benefit of the LEAP self-generated research experience for supporting science-related motivational beliefs, achievement, and career-related beliefs/choices. (3) Evaluate the effect of fostering incremental ability beliefs on science-related motivational beliefs, achievement, and career-related beliefs/choices for URMs. (4) Examine the underlying psychological processes (e.g., motivation) that explain why the LEAP interventions and incremental ability treatment alter students' science achievement and career-related beliefs/choices.
McGee, Richard	The primary research objective is to determine if a systematic coaching process can be developed and deployed that increases the likelihood and success of underrepresented minority scientists, particularly with respect to academic careers. The coaching process is likely to benefit young life scientists irrespective of gender, race and ethnicity, but the hypothesis is that it will have more benefit for students at higher risk of marginalization. At the same time, by allowing individual coaches (faculty who have demonstrated skill and commitment to mentoring and other professional development roles) to engage students with their own styles, we are studying different styles of coaching to determine which works best. Finally, by using social science theories to design the

Project PI(s)	Research Aims & Questions
	Academies, we are testing the degree to which those theories can be effective in guiding interventions to promote success of underrepresented students in pursuit of research careers.
McGee, Richard; Remich, Robin; Wood, Christine; Brdyn, Adriana & Campbell, Patricia	Our primary research objectives are to answer fundamental research questions, such as: 1. How do minority and non-minority scientists in training view the desirability of academic careers and their confidence in succeeding in them? How does this view change during training? 2. What are the most critical perceptions, fears, or life preferences that keep young scientists from pursuing academic careers? Which of these are addressable by interventions, which would require institutional or scientific community changes, and which are primarily life choices? 3. How do design elements common among MARC, RISE, IMSD, and PREP programs, or unique elements in some programs, impact their efficacy at guiding students toward academic careers? 4. What themes or characteristics predict persistence to completion and continued interest in conducting research, especially in an academic setting? 5. To what degree can social science theories (e.g., identity formation, cultural capital, Communities of Practice, Social Cognitive Career Theory, creativity, etc.) explain the processes by which young scientists develop within research groups and the broader biomedical community? 6. What are characteristics and expectations among entering PREP Scholars? Why weren't they ready for graduate school before entering PREP?
Reede, Joan Y.	Overall: To advance a diversity inclusion agenda using a systems-based perspective that enhances our understanding of factors that hinder or support the careers (i.e. promotion, retention, and productivity) of faculty in academic medicine, with particular attention on under-represented minority individuals and women. Research aims for the new study: 1. To characterize patterns and rates of change over a five-year period of coauthor networks for faculty at a research intense academic medical center 2. To describe the compositional and functional components of faculty career networks among junior faculty in three departments of medicine, and to explore how faculty build career networks including the contribution of coauthor connections within these networks. 3. To identify individual and organizational determinants of career network formation, coauthor network size, and patterns of change in coauthor networks over five years for faculty in three departments of medicine.
Rodgers, John & Hebl, Michelle	Our primary research objective is to test the specific Ibarra-Brown hypothesis that homophilic psychosocial mentoring significantly promotes professional success, and a more general hypothesis that greater diversity of personal mentoring networks promotes professional development. In the larger sense, "diversity" can be calculated in terms of the variety of different mentoring subfunctions, interaction partners, the distribution of functions provided through different partners, the frequency and duration of different partners. By characterizing the 'mentoring environments" of different schools (including demographic frequencies of faculty and students) and normalizing for objective academic and demographic inputs (parental income and education, for example) we hope to build a model that can estimate partition coefficients that describe the effect of mentoring diversities on the probability of a student accessing a productive labs, time to milestones, and publishing productivity. These models should help guide policy for constructing mentoring programs and environments.
Schneider, Barbara	We had one major objective this year, which was to learn if our intervention increased: (1) college enrollment; and (2) choice of a science major in college. We also undertook a simulated analysis of our findings to determine how consistent they were with national estimates.

Project PI(s)	Research Aims & Questions
Schultz, Wesley & Estrada, Mica	Research Questions: 1. Does participating in the RISE program increase the likelihood that a minority student will pursue a career in the biomedical sciences? 2. Are there some types of students who benefit more from the RISE program than others? 3. Are there elements of the RISE program that are linked with the success of the students? We focus on four core assumptions involving the variables of science self-efficacy, science identity, motivation, and values.
Shapiro, Jenessa R.	The primary research objective is to test new stereotype threat interventions designed to increase the interest of women and minorities in STEM majors and careers.
Smith, Jessi L. & Thoman, Dustin B.	Research Questions: 1) Do perceived levels of cultural connection to research in faculty mentor's labs (and changes in these levels over time) influence Latino and Native American undergraduate science research assistants' (RA) motivation for and pursuit of biomedical careers and graduate study? 2) Does greater perceived congruency between communal purpose goals and science research task goals mediate the influence of perceiving great cultural connection to research on interest in and pursuit of Biomedicine for Latino and Native American RAs? 3) Can RAs' perceptions of cultural connection to research be increased through a guided exercise to explicitly connect science lab duties to culturally relevant purpose goals and faculty mentor lab setting?
Tai, Robert; Wathington, Heather; Jeffe, Donna & Andriole, Dorothy	The main research objective was to identify factors related to educational and career experiences and activities and examine the link between these experiences and activities on MD and MD/PhD career choice outcomes
Wilson, Robin Taylor; Kaelin, Mark & Huebner, Wendy	Research Objective(s) 1) Determine whether interest, motivation and/or preparedness to pursue a biomedical research career are greater among students who receive the "Think Like an Epidemiologist Challenge" (Epi Challenge) intervention compared with students who do not 2) Determine whether adoption of career assessment and planning tools by high school career counselors influences motivation and/or preparedness to pursue a biomedical research career. Design: Randomized intervention study with pre-/post testing.

APPENDIX D: RESEARCH CENTRAL VARIABLES

Project PI(s)	Outcome Variables	Mediating/Moderating Variables
Anderson Snyder, Lori; Spicer, Paul & Pendley, Joy	Academic/Career success	Contextual inputs, learning experiences, self-efficacy expectations; communal goals, perceived cultural connection to mentor
Arora, Vineet & Meltzer, David	Interest on a biomedical career	Peer influence via social media vignettes
Boekeloo, Bradley & Timmons-Brown,	Pursuit of college education for a BBR career (college applications,	Mediating motivation variables-- (theory of planned behavior constructs: attitude, subjective norm, perceived

Project PI(s)	Outcome Variables	Mediating/Moderating Variables
Stephanie	college prep courses, college admissions test prep courses, college visits, speaking with college admissions counselors)	behavioral control, intention); self-efficacy. Mediating knowledge variables: modification of characteristics and benefits of academic career in dentistry. Covariates: school; age; gender; race/ethnicity; birth place; parent occupation, income, and education; intensity of PTC activity involvement
Bowman, Phillip	Successful Program Outcomes: STEM/BBS Major Choice/GPA, STEM/BBS PhD Plans/Outcomes, STEM/BBSRC Plans/Outcomes	Intervention Participation (Program vs. Control Gps.) 1.Intervention Strengths: a. Formal/Informal Program Support Mediators b. Informal Faculty Mentor Role Mediators 2.Adaptive Social Psychological Strengths: a. Social-Cognitive Motivational Mediators b. Social-Cognitive Engagement Mediators 3.Student Role Strain Moderators: a. Objective Barriers – Financial, Academic, Status Subjective Appraisals – Discouragement, Stress
Braden, Carrie Jo; Lesser, Janna & Cantu, Adelita	Proximal outcome -- Team reflexivity behaviors; Distal outcome -- Scholarly productivity and career path planning	Motivator direction & strength, interpersonal risks, team psychological safety, learned resourcefulness, research self efficacy, student characteristics, training program characteristics
Byars-Winston, Angela & Pfund, Christine	Intention to pursue a career in biology	Research causal variables in mentoring relationships, person inputs, background contextual factors, and learning experiences, self rating of research skills and knowledge, and mentor effectiveness predicting mentee research confidence.
Cassad, Bettina	Educational outcomes: academic performance, values, engagement, identification, and persistence; psychological well-being (depression, anxiety, performance self-esteem)	Vigilance for stigma and uncertainty; gender-relevant environmental cues e.g. numerical minority status, teacher bias, test diagnosticity; individual differences (stigma consciousness, gender rejection sensitivity, implicit intelligence theories, gender identification, domain anxiety, experiences with and expectations for performance, optimism, perceived control, self-esteem; stereotype threat; physiological processes (threat vs. challenge responses); cognitive processes (working memory depletion), affective processes, motivational processes (task persistence)
Chang, Shine & Cameron, Carrie	The assessment of oral and written communication skills by mentors and trainees	Strategies that mentors use to improve mentees oral and written communication skills, factors that modify the ability, confidence, or desire to engage in written and oral communication (for mentees).
Frantz, Kyle; Goode, Chris; Britner, Shari L.; Carruth, Laura L.; DeHaan, Robert L.; Demetrikopoulos,	Science self-efficacy, leadership/teamwork self-efficacy, science identity, science/neuroscience anxiety, commitment to science	Science identity, science self-efficacy, representativeness of ethnicity in science

Project PI(s)	Outcome Variables	Mediating/Moderating Variables
Melissa K.; Pecore, John L. & Williams, Brian A.		
Gaughan, Monica & Chowell-Puente, Gerardo	Survival at career milestones (degree completion, academic progression, entry into career, productivity in career, timely promotion)	Intervention participation by time of intervention, demographics and other covariate controls
Gershon, Robyn; Ozer, Elizabeth & Feldman, Mitchell	Intention to pursue a scientific research career	Psychosocial and contextual factors: self-efficacy, science identity in URM and non-URM doctoral students
Girotti, Jorge; Schwartz, Alan; Oláguez, Kendy & Barnes, Jessica	Attitude towards science; Participation in science;	Program intervention; participation in science related activities; influence of environment (i.e. school, peers, home) Hispanic acculturation status; Social network; congruency of peers (school- vs. non-school peers)
Harackiewicz, Judith & Hyde, Janet	Shorter-term: Interest in Biology; Semester grade, Career plans Long-term measures: Overall GPA, Biology and science course-taking through graduation, Academic Major	Value affirmation, utility value intervention.
Hedges, Larry	Examine the effects of the prizes for research awarded at the Annual Biomedical Research Conference for Minority Students (ABRCMS) over the last decade	Possible mechanisms: 1)Signaling, 2) Identity formation (identity theory), 3) Self efficacy (cognitive evaluation theory), 4)Altering subjective probability of success (expected utility/cumulative prospect theory
Hurtado, Sylvia & Eagan, Kevin	Students' enrollment into graduate and professional programs, retention in the biomedical and behavioral sciences (BBS) and intention to pursue a scientific career.	Individual and institutional barriers/facilitators of underrepresented racial minority (URM) students' progression toward research careers in the biomedical and behavioral sciences (BBS). Goals, level and types of engagement, graduate school experiences (e.g., academic preparation, socialization, mentoring, research opportunities, etc.), and perceptions about campus diversity vary by race/ethnicity, undergraduate experiences, and institutional contexts
Jeffe, Donna & Andriole, Dorothy	Among U.S. medical graduates : 1) promotion and attrition among MD-degree graduates with full-time academic medicine faculty positions, 2) time to promotion and attrition and MD-degree graduates , 3) receipt of individual NIH fellowship (F), career development (K), and research (R) grants; among MD-degree holders and among MD-PhD degree holders, and 4) full-time faculty appointment among MD-PhD	We previously identified several mediators of the association between race/ethnicity and physician participation in biomedical research (operationalized as having a full-time academic-medicine faculty position) among MD-degree program graduates: formal research participation in college, medical school, residency; authorship on a manuscript during medical school, academic achievement, faculty career intention at graduation.

Project PI(s)	Outcome Variables	Mediating/Moderating Variables
	dual degree program graduates	
Krupat,Edward	Prospective study: Intention to pursue a research career (asked in multiple, ways) Retrospective study: Current professional responsibilities and activities	1) Positive-negative value (attitude) toward research as a career 2) Subjective norms 3) Perceived behavioral control (i.e., self-efficacy) 4) Stereotype threat 5) Demographic variables
Lev, Elise & Sanzero Eller, Lucille	Ability to perform research-related tasks and activities, clinical research self-efficacy	Mentor Workshops, face-to face, internet, or booklet no-contact interventions.
Lewis, Vivian	Perceived fulfillment of psychological needs being met in the academic workplace	Comparing the effects of a mentoring education intervention. 1) Primary mentor participates in educational intervention 2) Protégé participates in peer mentoring group 3) Combined intervention: Primary mentor receives educational intervention and protégé participates in peer mentoring 4) Control: Primary mentor may participate in educational intervention after 1 year
Linnenbrink-Garcia, Lisa & Schwartz-Bloom, Rochelle	Perceived competence, science self-efficacy, interest/value, cost, feelings of belonging, beliefs about ability, achievement goal orientations, perceived stereotype threat, science identity, career aspirations and expectations, educational aspirations and expectations, science concept knowledge, major, minor, science course grades, graduate/professional school matriculation, current job status	Within pharmacology enrichment program (LEAP): random assignment to one of 4 treatment conditions (incremental ability research experience; multiple ability, research experience; incremental ability, no research experience; multiple ability, no research experience). Comparison of LEAP program participants to no treatment control group. Gender, ethnicity. Mediating variables: self-efficacy, interest/value, achievement goal orientations
McGee, Richard	Success of minority science students in obtaining biomedical research careers	Coaching style, closeness of coaching group, self-efficacy of future academic career goals
McGee, Richard; Remich, Robin; Wood, Christine; Brodyn, Adriana & Campbell, Patricia	Obtaining a career in the biomedical workforce.	Identity development, cultural capital, Communities of Practice and Social Cognitive Career Theory
Reede, Joan Y.	1) Career advancement (time to promotion, promotion); 2) Productivity (grants, publication count, citation count, h-index); 3) Co-author network composition (race-ethnicity, gender, seniority, location, discipline)	1) Demographic characteristics (race-ethnicity, gender); 2) Intra-organizational research connectivity (second degree reach); 3) Fellowship; 4) Publication bibliometrics (number of publications; h-index; single/first/last authorship); 5) Discipline compositional factors; 6) Mentoring award nomination/receipt)

Project PI(s)	Outcome Variables	Mediating/Moderating Variables
Rodgers, John & Hebl, Michelle	Pursuit of a biomedical research career	Mentoring environment/diversity of interaction
Schneider, Barbara	College attendance, biomedical major in college, persistence in postsecondary school	Percent of students enrolled in advanced-level mathematics and science courses, aspirations and knowledge about a scientific research career
Schultz, Wesley & Estrada, Mica	1) Change in intention to become a scientist 2) Baccalaureate graduation 3) Graduate school application rates 4) Graduate & Medical school enrollment rates	1) MTP program elements: financial support, research experience, faculty mentorship 2) Process of influence variables mediating the relationship between the program elements and intention to pursue a biomed career (science self-efficacy, scientific identity and value of science objectives)
Shapiro, Jenessa R.	Interest in STEM majors and careers	Stereotype threat, class choice, major choice, GPA, self-reported office hour attendance, evaluation of classes, evaluation of professors, research experience
Smith, Jessi L. & Thoman, Dustin B.	1) Biomedical research career interest	Culturally-connected communal goals, Perceived congruency between science task goals and communal purpose goals
Tai, Robert H.; Wathington, Heather; Jeffe, Donna & Andriole, Dorothy	Career decisions at four transition points: 1) students planning careers in biomedical research who considered MD, MD/PhD, or PhD programs for graduate school; 2) medical school students planning research involvement who did or did not enroll in MD/PhD programs; 3) Students enrolled in MD/PhD programs who did or did not graduate; 4) MD and MD/PhD program graduates who are or are not engaged in primarily research-based careers	Demographic, attitudinal, and experiential factors (prematriculation and medical school factors)
Wilson, Robin Taylor; Kaelin, M. & Huebner, Wendy	Interest, motivation and preparedness to pursue a biomedical research career	School-specific factors (e.g., training of high school career counselors); individual factors (e.g., gender, race/ethnicity, family income, and career goal-setting).

APPENDIX E: PARTICIPANT EVALUATION OF THE 2014 CONFERENCE

Evaluation Report

Background

Attendees of the Interventions 2014 Progress Report Meeting on August 14th and 15th completed evaluation forms to assess the usefulness of the meeting format and to identify areas for improvement. They completed several multiple-choice and open-ended questions evaluating strengths of the conference, making suggestions for roundtable discussions and improving presentations, as well as preference of location. Of the 50 conference attendees (excluding conference organizers and special guests), 44 (88%) completed the 2-page evaluation form at the conclusion of the conference.

Strengths of the Conference (Total Responses= 55)

Theme	*Number of Comments*	*Examples*
Networking	15	Everyone having plenty of opportunity to network, engage, and receive feedback on their work, exchange ideas (11), opportunities for informal meetings and connections (3), intimate size allows for much interaction (1)
Sharing & Learning	19	New knowledge from progress reports (4), fruitful discussions (5), and learning about new methodologies and similar projects (2), getting feedback on your own work (2) sharing methods, emphasis on new projects (1), Cliff was great (4) bring him back (2), great range of research (3), Talking with NIH personnel (2), forum for discussion of testing training assumptions (1), opportunity to discuss with and learn from experts (1)
Meeting Format	3	Well organized (3)
Collaborative & Supportive Environment	5	Collegial environment (1) Good to be with group that has same goals, learning about the work of others (4), insightful suggestions, chance to use others' references, tools, etc., potential to identify new collaborators and develop innovative ideas (4)
Conference Logistics	13	Roundtable discussions were strong (8), food great (5), private reception was good (2), setting the pace was strong (2), outdoor eating (1), breaks good (2)

Results

Symposia

- Overall, the evaluation forms revealed that attendees viewed the symposia as very useful (mean=4.61 on a 5 point scale). The majority of attendees felt that teams were allotted the right amount of time for the presentation of new findings (10 minutes; mean=2.75 on a 5 point scale where 1 = Much too little time; 3 = Perfect amount of time; 5 = Too much time)

Roundtable Discussions

- Attendees generally perceived the roundtable discussions between somewhat and very useful (mean=4.32 on a 5 point scale). Generally, attendees felt that everyone had the right amount of time to express their opinions (mean= 3 on a 5 point scale where 1 = Much too little time; 3 = Perfect amount of time; 5 = Too much time).

Suggestions for Meeting Improvements (Total Responses = 52)

Theme	*Number of Comments*	*Examples*
Time-Related Concerns	14	9AM start time (1), start a little later (1), open half-day so attendees can visit area (1), make meeting full 2 days (2), not enough time (2), run from Tues night-Friday afternoon (1), additional 5 minutes per presentation (3), more time for presentations (2), obtain abstract book earlier (1), Did not appreciate "requiring" speakers to follow timeline (1), more roundtable time (2), longer Q&A sessions with program officer/NIH personnel (1)
Clarification and Additional Format Concerns	4	Create sub-topic interest groups based on funded project focus (2), Ask presenters to begin with background/big picture slide(1), include grant numbers for each (1)
Increased Networking, Dissemination, and Continuation of Information Sharing	6	address intersection of social identities(1), discuss stereotype threat management (1), having access to slides (printouts, secure website) during presentations (2), document conference-especially major themes, what collaborations stemmed from and what areas need to be addressed (1), support for new grantees (1), share resources-measures etc. (1), include list of publications on white paper (1)

Conference Logistics	10	Longer conference (1), Organize presentations by level in the pipeline (1), need one-on-one time to talk to PIs (program officers) (1), Synchronize with the Understanding Interventions meeting (1), one week earlier to avoid conflicting with start of school (1), less presentations per day (1), guided discussion at end in room (1), include a synthesis at the end of day 1 and at the end of the meeting (1), include open discussion time (1), invite campuses involved in STEM innovation and change (1)
Overall Satisfaction with No Desire for Change	18	Great job, the approach for next years conference should be the same, this year's was excellent!

Meeting Format

A) How useful did you find the symposia? (M = 4.61, SD = .58)

1	2	3	4	5
Not at all useful		Neutral		Very useful

B) How helpful was it to have the abstract briefing book to review before each talk? (M = 3.77, SD = 1.09)

1	2	3	4	5
Not at all helpful				Very helpful

C) How did you feel about the timing of the presentations? Should each team have had more, less, or the same amount of time? (M = 2.75, SD = .69)

1	2	3	4	5
Much too little time		Perfect amount of time		Too much time

D) How useful did you find the roundtable discussions following each symposium? (M = 4.32, SD = .67)

1	2	3	4	5
Not at all useful		Neutral		Very useful

E) Overall, how much did you feel that everyone had the opportunity to express their opinions? (M = 3, SD = .75)

1	2	3	4	5
Much too little time		Perfect amount of time		Too much time

Recommendations

Where would you prefer next year's meeting?

- Back at Lowes Coronado (San Diego area) **22**
- Embassy Suites Burlingame, CA (San Francisco area) **4**
- Somewhere else **9**
  -West Coast **2**
  -East Coast **1**
  -Washington DC **1**
  -Central States (to minimize time zone crossing) **5**
    -Chicago **1**
    -Wisconsin **1**
    -Denver **1**
    -Santé Fe **1**
    -San Antonio **1**