Coaching to Augment Mentoring to Achieve Faculty Diversity: A Randomized Controlled Trial

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Abstract

Purpose: The *Academy for Future Science Faculty* is a novel coaching intervention based on social science theories for biomedical PhD students designed to address limitations in previous efforts to promote faculty diversity during PhD training. First, we present an in-depth qualitative case-study of one of the coaching groups. Second, we explore statistically whether one year in the *Academy* impacts students' perceptions of the achievability and desirability of an academic career.

Method: The *Academy* is being tested via a longitudinal randomized controlled trial with equal numbers of students by gender, race and ethnicity in the coaching groups. Participants for this study were 121 PhD latter-stage PhD students in the biomedical sciences. Data discussed in this paper were collected between July 2012 and July 2013 in Chicago or via telephone. The population for this This study was reviewed and approved by Northwestern University's Institutional Review Board, Project STU00035424.

Results: Our case study showed how a an academic career coaching model can: effectively supplement traditional research mentoring; provide new role models for underrepresented minority students; and provide theory-based lenses through which open, meaningful conversations about race, gender and science careers can be engaged. Repeated-measures ANOVAs showed that the *Academy* had a statistically significant positive effect on both perceived achievability and perceived desirability of an academic career. Perceived achievability increased in the Academy group from baseline to 1-year follow-up (means, 5.75 vs. 6.39), but decreased in the control group (6.58 vs. 5.81). Perceived desirability decreased

significantly less sharply from baseline to follow-up (7.00 vs. 6.36) in the Academy group, than in the control group (7.83 vs. 5.97). The *Academy* was comparably beneficial to minority and non-minority students, and to males and females.

Conclusions: Early results suggest that an academic career-coaching model can effectively supplement traditional research mentoring and promote persistence towards academic careers.

In the biomedical sciences, student interest in academic careers declines significantly during doctoral training.[1-2] This decline is due to a number of factors, but primarily to the low availability of faculty positions and the challenges to succeeding for those who attain them.[3] Additionally, underrepresented racial and ethnic minority (URM) and female PhD students often encounter stereotyping, discrimination, and isolation, which can serve as added deterrents to academic careers.[4] For young URM and women scientists, finding faculty role models from similar backgrounds is important but challenging across the academic medicine pipeline.[5-9]

Traditional research mentoring is highly idiosyncratic with varying degrees of effectiveness. Although recent approaches are proving to be successful at improving the quality of mentoring,[10-13] the effects are small. We argue that there are inherent limitations to mentoring as the predominant research training construct, especially for the success of URM and women scientists. We believe many of these limitations can be addressed by supplementing traditional one-to-one research mentoring with a group-based "coaching" model (Table 1). Specially-trained Academic Career Coaches (described below) can provide independent guidance for navigating graduate school and future academic careers.

Table 1 about here

In our coaching model, we build on four social science theories that reveal the social and cultural factors that impact all young scientists, particularly URMs and women: Identity formation, Social Cognitive Career Theory (SCCT), cultural capital and Communities of Practice. A full discussion of these theories is beyond the scope of this paper. However, they are discussed briefly in Supplemental Digital Appendix 1, and more in-depth in our study protocol.[14] Identity formation as applied to science careers focuses on the ways individuals come to view themselves as scientists based on the meanings they create about their experiences.[15-17] SCCT focuses on the ways individuals develop their career-related confidence (self-efficacy), interests and goals.[16, 18] Cultural capital focuses on how career promotion is influenced by how well an individual is perceived to fit within the "field" (social environment) of professional science, based on their "habitus" – that is, their embodied and culturally-ingrained skills, tastes and dispositions.[19-21] Communities of Practice reveals the social context of learning to be a scientist.[22-23] Our coaching model was designed to both impact students' perceptions of academic careers, and to help students achieve them by addressing the identity, self-efficacy and cultural capital that must be developed as students navigate research Communities of Practice.

In this paper, we discuss early results from our longitudinal randomized controlled trial of the "Academy for Future Science Faculty" (hereafter "the Academy"), a novel coaching intervention for U.S. biomedical PhD students.[14] The first part of this report presents an in-depth case-study of one coach and the ten students in her coaching group, to reveal how a coach, and the group, works to provide support, sustain interests, and promote progression, particularly among URM and female students. The second part explores whether one year in the Academy impacts

students' perceptions of academic careers. We use the constructs of 'perceived achievability' and 'perceived desirability' as two important components that contribute to interest in academic careers. Although our primary aim was to positively impact perceived achievability, we also explored whether the Academy affected the desirability of an academic career. We expected that providing students with a supportive, carefully tailored environment within which they interact with successful academic scientists and like-minded colleagues would have a positive impact on both perceived achievability and desirability. Thus our hypotheses were:

H1: The Academy group will experience a positive effect on perceived achievability of an academic career, compared to the control group.

H2: The Academy group will experience a positive effect on perceived desirability of an academic career, compared to the control group.

Methods

Extensive details about the design and methods used in the Academy trial can be found elsewhere.[14] The Academy study was reviewed and approved by Northwestern University's Institutional Review Board, Project STU00035424.

Participants

The Academy trial included two arms: one with students just starting their PhD, and one with students nearing completion of their PhD. In this paper, we present findings from the second arm of the trial only, to provide details of the impact of the intervention on students about to make important decisions impacting their future careers. Future reports will explore the

findings from earlier-stage students. Eligibility criteria for this arm were: (a) enrolled in a U.S. biomedical PhD program, (b) expressed interest in an academic career, (c) US citizenship or legal permanent residence, (d) within approximately 18 months of PhD completion. The study period discussed in this paper was July 2012 to July 2013. Applications were solicited from biomedical PhD programs throughout the U.S. using a variety of electronic mailing lists of faculty advisors. Overall, 340 applications were received from 113 institutions, of which 121 eligible students (from 74 institutions) were chosen. Students were chosen and then allocated using a random-stratified approach. 60 students were allocated into the Academy intervention group and 61 into the control group. The initial intent was to stratify so that both Academy and Control groups included approximately 30 men and 30 women, and 15 each of white, Asian, Hispanic and Black students, to allow comparisons by gender, race and ethnicity both within the Academy and between Academy and Control groups. However, we received insufficient applications from Asian, Hispanic and African American students to fulfill this design. We opted to first fill the stratification into the Academy to permit within-Academy comparisons and retain the novelty of the Academy community, but in so doing we were unable to achieve sufficient numbers of non-white students in the Control group to make comparisons between URM and non-URM students statistically possible. The distribution by gender, race and ethnicity is provided in Table 2. Of the 121 advanced-stage students in both groups, 72 students (36 Academy, 36 Control) returned surveys both at the start and end of the first year, and thus are included in our statistical analyses. Although the response rate was 60%, X^2 test revealed no significant differences between responders and non-responders in terms of URM status or

gender ($p>0.05$), and thus we do not have reason to believe that our results are significantly affected by nonresponse bias.

Table 2 about here

Six "Academic Career Coaches" (hereafter "Coaches") were recruited from leaders of research training and diversity efforts in U.S. universities. Announcements were made through program and organization electronic mailing lists (Graduate Research and Training (GREAT) group of the Association of American Medical Colleges (AAMC); leaders of National Institute of General Medical Sciences (NIGMS)-funded student development and training programs). Coaches were trained by the Principal Investigator and a team of social scientists during an initial 2-day meeting and in subsequent remote conferences. A key element of the training was teaching the social science theories, as outlined in Supplemental Digital Appendix 1. To facilitate discussion and understanding of the theories, a 'theory decoder' was constructed to describe each theory and how it applies to biomedical research training and careers.[14]

Prior to the 2012 Academy meeting, students were split into six groups of ten, with each group allocated one Coach. Each coaching group was stratified such that no race/ethnicity or gender was a majority.

Intervention

The Academy intervention included a two-day, in-person meeting that took place in Chicago, Illinois. The meeting consisted of group presentations and panels, and coach-facilitated activities in individual coaching groups. Between annual meetings, coaching groups were

encouraged to meet regularly via web-conferencing, and maintain group contact via emails and social media. Coaches were asked to also maintain regular one-to-one communication with students through emails and telephone. Coaches and coaching groups addressed any issues they deemed relevant for professional and personal advancement, for example post-doctoral planning, completing and defending the dissertation, professional networking, interpersonal skills, and stress-reduction and coping skills. Students also completed practical activities and tools, such as an Individual Development Plan (IDP) and a self-assessment tool, and subsequently discussed this in groups and with their Coach. Discussions on diversity, difference, and discrimination within academic science careers were initiated within the Academy group as a whole and were continued by Coaches in their groups.

The social science theories were presented to students from the perspective of science and research training. Coaches drew on the social science theories and referred back to them as they became relevant during discussions. Identity conflicts and contingencies, assumptions and unequal treatment by lab group communities of practice, and the impacts of ongoing stereotype threat and imposter syndrome were among the situations that commonly arose. Further details of the social science theories and how they were taught and operationalized are provided in our study protocol.[14]

Qualitative case study

A qualitative case study approach was employed because this method is particularly relevant for research questions that seek to explain how or why some social phenomenon works and which require an and "in-depth" description of it.[24] One of the main novelties of the Academy

lay in its use of small-groups as the focus of coaching compared to the one-to-one focus of traditional mentoring. As such, the most appropriate "unit of analysis" or "boundaries" for our case study is the coaching group.[24] Looking at one coaching group of ten students allowed us to go into greater depth in our analyses. Using criteria discussed by Yin, we chose our case based on sufficient availability of data and based on data that "will most likely illuminate your research questions".[24] As such, rather than choosing a coaching group at random, we chose the one that had met most frequently and thus provided us with the richest amount of data. It is important to bear in mind that the findings apply specifically to the case from which they were derived. However, preliminary analysis across the other 15 coaches suggests that many of these themes will emerge as consistent elements of successful coaching groups.

At annual meetings the principal investigator (RM) led the Academy activities while the other two authors (SW and BT), collected data via ethnographic observation and audio recordings of coaching group meetings. All three authors have extensive experience with qualitative methods. Coaching group virtual meetings were observed and audio recorded and substantive email conversations between students and Coaches tracked. Annual in-depth telephone interviews with students were conducted by members of the research team before each Academy meeting. Coaches were interviewed periodically.

Qualitative data were analyzed and coded using the qualitative analysis software NVivo Version 10,[25] with a coding architecture developed initially using a grounded theory approach. Grounded theory methods allowed us to start with larger, initial or "open" codes that reflected our larger objectives.[26] All three authors were involved in the development of the initial open

coding. Subsequent "selective" coding was performed on the key open codes, which for the purposes of this paper, were "relationship with Coach"; "relationship with coaching group" and "how the Academy has or has not been useful or beneficial or impactful". (As described elsewhere, individual interviews covered a wide array of topics related to personal, academic and scientific experiences. Analysis of other research questions from those data will be the subject of future reports.) The first author of this paper, who consulted with the remaining authors at various points during the analysis, led this more selective coding process. Iterative memoing and discussion amongst the research group was performed throughout in order to ensure a constant comparative approach.[26] This process was guided by the more abductive model of Grounded Theory favored by Strauss and Corbin.[14, 26, 27] The final codes that developed are presented below and were guided by our main aim of capturing the ways coaching group interactions disentangle challenges to achieving an academic career. The latter portion of the interview was dedicated to questions that sought to probe the students' perceptions of their participation in the Academy, and it is from these questions that much of the data for this study emerged. We provide one or two sample quotes for each theme, but they are representative of many similar comments within each theme.

The case study coaching group consisted of 1 Asian female, 1 Asian male, 2 Black females, 1 Black male, 2 Hispanic females, 2 white males, and 1 white female. Students were working on PhDs from a range of disciplines, and no two students were from the same graduate institution. 9 students (all except one white male) were available and were interviewed. The Coach was a mid-career Hispanic female from a medical school, with considerable experience in biomedical

research and graduate students mentoring, and a particular interest in promoting faculty diversity.

Quantitative survey

On-line surveys were administered just prior to annual phone interviews before Academy meetings. Key outcome measures of interest were the 'perceived achievability' and 'perceived desirability' of an academic career, both of which students marked on a 1-10 scale (with 1 being lowest). Students' race/ethnicity was grouped into a dichotomous variable, with URM consisting of Black, Hispanic and Native American students, and non-URM consisting of White and Asian students.

Statistical analyses

One- and two-way ANOVAs (SPSS Version 21[28]) were used to explore possible differences between groups before the Academy started. Also, two separate 2 x 2 repeated-measures ANOVAs were conducted, one for perceived achievability (model 1) and one for perceived desirability (model 2) of an academic career. Both models included 1 within-subjects factor with 2 levels (*Time*: Baseline/Follow-up) and 2 between-subjects factors, both with 2 levels each (1. *Experimental Condition*: Academy/Control; 2. *Gender*: Female/Male). We explored main effects and interaction effects (both for Time X Experimental Condition and for Time X Experimental Condition X Gender).

Due to the low numbers of URMs in our control group (Table 2), URM status was not included in our repeated measures models.

Results

Qualitative case study

What is Career Coaching in the Academy model?

In describing her role, the Coach discussed how she ranged from creating a safe and open environment for the students to providing specific career-related advice, personal and professional encouragement, and support, depending on the needs of each student. She also discussed how the types of conversations she had as a Coach supplemented the conversations students were having with their mentors, and that her coming from a different institution enabled these types of conversations:

> "I wanted to make them all comfortable, and to feel that our coaching group is a safe place for all of them."

> "There are some of my students that know what they want, and the only thing I need to do is be the cheerleader, and be the one giving them the pep talk … [then] there's some that are lost and have no idea what they want, and I have to be more of the listening ear."

> "[T]he other thing that I'm finding is that the mentors are really not creating the space for the students to feel comfortable to say, 'OK, what are your plans, your dreams, your goals?'... We [the Academy] are having those conversations."

> "I feel very free with them because they are not directly linked to my work ... I am very free to just be a support."

Grounded theory analysis revealed six main themes that helped distinguish coaching support from traditional research mentoring. These themes are discussed in Table 3. Overall, these themes display how the coach and the coaching group buffered challenges faced by students and provided tools and guidance to promote professional persistence.

Table 3 about here

Having "difficult conversations" about race, gender and science careers

Analysis also revealed a seventh theme that was prominent among the URM students in the group. In the diverse environment of the Academy, once a safe space had been established, Academy presentations and coaching groups discussed diversity, difference and discrimination in science. For several URM and female students in particular, this safe space, along with the new social science theories and concepts, helped reduce their anxieties concerning their identity as a scientist. As one African-American female student described:

> "When you're an underrepresented minority, and I think it would be gender too, there's these whole theories like, Stereotype Threat [and] Imposter Syndrome that does [sic] play a part … and [in the Academy] I was introduced to those two concepts and I thought, oh, I didn't know that this was called something … It's not just science, it's social influences … because nobody likes to say this. You don't want to mention race because you don't want to feel like you are playing the race card… and when it comes to the whole identity type things, I always felt like I was at odds with 'who are you?' … before the Academy I was so deathly afraid of not getting my PhD, because I feel like a lot of students along the way, some of them would be, URM's, have not gotten their degrees. They start with passion and diligence and you just never see what's coming… And you see all these battles and I was just so afraid… because I thought of these

different identities you don't fit with what it is to be a scientist. … And [my coach] told me it's OK to be more than one thing … I think that really gave me peace."

As she neared the completion of her thesis, the student reflected on how the Academy had helped during her graduate school experience:

"I am defending my thesis in 2 weeks. As you all know, my time at [Graduate School] has been filled with many challenges. Approaching this milestone, I would like to say thanks for your support as I navigated a tough graduate school journey."

Quantitative analyses of perceived achievability and desirability of academic careers

Achievability

Quantitative results and statistical analysis are provided in Table 4 and Table 5. At the start of the trial, including Academy and control students, there was no significant difference between men and women, or between URMs and non-URMs for perceived achievability.

However, a repeated-measures ANOVA showed that perceived achievability increased in the Academy group from baseline to follow-up (means, 5.75 vs. 6.39), but decreased in the control group (6.58 vs. 5.81). Gender, did not make a difference; achievability increased in the Academy group and decreased in the control group similarly for men and women.

Table 4 about here

Desirability

At the start of the trial, including Academy and control students, there was no significant difference between men and women or between URMs and non-URMs for perceived desirability. However, males in the control group (M=8.60) had significantly higher desirability than males in the Academy group (6.69), which we consider an anomalous product of the randomization process.

A repeated-measures ANOVA showed that perceived desirability decreased in both Academy and control groups, but it decreased significantly less sharply from baseline to follow-up in the Academy group (7.00 vs. 6.36), than in the control group (7.83 vs. 5.97). This ANOVA also revealed a statistically significant interaction between the effects of the experimental condition and gender on perceived achievability over time. For females, the decline in desirability in the Academy group from baseline to follow-up (7.17 vs. 6.61), was similar to the decline in desirability in the control group (7.24 vs. 6.38) in the control group. For males however, the decline in desirability in the Academy group (6.69 vs. 5.92), was significantly less than the decline in desirability in the control group (8.60 vs. 5.40). However, this difference was partly influenced by the high starting values for control males.

Table 5 about here

Discussion

The ultimate career paths of the participants, and the impacts of the Academy, will take years to determine as we follow them into their next and future career steps. However, these analyses reveal initial insights into how the Academy is impacting students' interest in academic careers as they complete their PhD. Our case study results support our argument that a career

coaching model can effectively supplement traditional research mentoring. Additionally, for URM students, the Academy provided diverse role models, new theory-based 'lenses' through which to interpret their experiences, and a safe space to discuss and obtain validation of the realities they face related to difference, diversity and discrimination within academia.

Baseline data showed that URM and female students did not start out feeling an academic career was any less achievable or desirable than non-URM and male students. The decline in desirability and achievability over the year for the control group aligns with other reports of declining interest over the course of the PhD.[1-2] In contrast, the Academy significantly improved students' perceptions of the achievability of an academic career. The intervention also significantly minimized the decline in desirability as compared to the control group. The main aim of the Academy was to positively impact achievability, since we felt that exposure to a diverse and expert group of specially-trained coaches would provide the knowledge and skills that would make an academic career seem more 'doable' to the students. Although the intervention had a positive effect on the Academy students' desirability relative to controls, we were not surprised to see that it still declined over time in the Academy group. Making an academic career more appealing is a broader and bigger problem than simply making it seem more possible. Structural factors such as the long training period required, and the never-ending need to seek outside funding while the NIH funding probability continues to decline, contribute to academia being viewed as undesirable. These structural barriers are beyond the scope of an intervention such as the Academy.

A decade ago, Pololi and colleagues demonstrated the effectiveness of a "collaborative peer mentoring program" for facilitating scholarly writing, and argued for the value of facilitated peer groups as a new paradigm for mentoring of junior faculty.[29-30] Group-based mentoring or coaching has not caught on in academic medicine, perhaps due to the staunch adoption of dyadic mentoring by one or more individual mentors as the prevailing model of both research and faculty development. On both theoretical and now research grounds, we believe significant progress in diversity within academic medicine will require a broader approach to professional development beyond classical mentoring. As noted earlier, structured approaches to development of research mentoring skills have recently arisen, with good evidence of immediate and lasting impacts on mentors.[11-13, 31] The Academy extends this concept to advanced training of skilled mentors to become coaches. Several advances are key to the training and deployment of Academy coaches, including a visible foundation on social science theories, a focus on group coaching, and the purposeful detachment of coaches from research mentoring in which mentors are dependent upon the research produced by their mentees.

One limitation of the study is the small number of URM students in the control group. In particular, the current data are unable to draw comparative quantitative findings from Black or Hispanic males due to the absence of Black or Hispanic males in the control. However, the effect of the Academy on URM students will be explored in future qualitative analysis by comparing them internally with other students of a different race/ethnicity and gender within the Academy.

The Academy coaching model is being tested only with biomedical PhD students. However, a similar design could be implemented for other populations, including clinical trainees pursuing research careers. Many institutional clinician scientist training programs (especially those supported by NIH K12 awards) do provide variations of structured coaching processes. However, URM trainees in those programs are just as rare as in PhD and postdoctoral communities and could benefit greatly from models like the Academy that bring them together in safe spaces to promote professional advancement.

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Tables

Table 1: Key differences between traditional research mentoring and Career Coaching

Limitations of Traditional Research Mentoring	***Academic Career Coaching as a Supplement***
Experience, training, skills and experience vary widely between different mentors, thus quality of mentoring received is idiosyncratic	Experienced and highly skilled mentors are recruited, and provide additional systematic and theory-based training.
Can often have conflicts of interest (e.g. between their own research or grant-writing interests and students' career interests, and between deciding who to promote or mentor within their lab)	Act as independent advisors and do not have a conflict of interest (coaches come from different institutions from their students and are bound by confidentiality agreements)
Face growing demands on their time, which means they have time constraints on their mentoring	Provide students with dedicated time and space for discussions, particularly geared to successfully navigating graduate school and future scientific careers
Can lack an informed understanding and a space to talk about of the impacts of being different, and the role that assumptions about race and gender can play in science	Undergo special social science based training in diversity. Provide students, particularly URM and female students, with a "safe space" to discuss sensitive issues related to "being different" within graduate school and academic careers.

Table 2: Characteristics of participants in the Academy Randomized Control Trial for latter-stage PhD students in the biomedical sciences, 2012-2013

	Total participating in the trial		**Provided complete data and included in this analysis**	
Characteristic	**Intervention, no. (% of 60)**	**Control, no. (% of 61)**	**Intervention, no. (% of 36)**	**Control, no. (% of 36)**
Gender				
Female	34 (57)	38 (62)	23 (64)	21 (58)
Male	26 (43)	23 (38)	13 (36)	15 (41)
Race/Ethnicity				
Asian	15 (25)	9 (15)	9 (25)	3 (8)
Black	15 (25)	9 (15)	9 (25)	4 (11)
Hispanic	15 (25)	9 (15)	9 (25)	5 (14)
Native American	1 (2)	0 (0)	0 (0)	0 (0)
White	14 (23)	34 (56)	9 (25)	24 (67)

NB: Participants who 'provided complete data' are those who completed the relevant questions in both the baseline and follow-up survey.

Table 3: Qualitative themes from grounded theory analysis of student interviews and group discussions

Qualitative Themes
1. Coach as independent advisor ***Summary****:* All 9 students discussed this theme. Students discussed how they benefitted from having a coach who was not from their institution, and thus gave "unbiased" advice. The students' felt that they benefitted from having the coach available to provide advice and encouragement. ***Sample quote(s):*** *"I have really enjoyed the benefit of having somebody who's not necessarily affiliated with my institution" (Black male)* *[S]he [the coach] was really accessible to me, even if I didn't always take her up on her offer. She said "you know, if you wanna text me or just email me if you're feeling, you know down – I really want you to be successful". (Black female)*
2. Coaching as a supplement for mentoring ***Summary***: All 9 students discussed this theme. They felt that their coach was able to fill in the gaps in their mentoring. Some students felt that their coach was a useful resource when their mentor was unavailable or unable to provide them with the career-related guidance and advice they needed. ***Sample quote(s):*** *"[S]ome of the things that I probably would have needed my PI for, [my Coach] was there" (Black female)*
3. Coach as a role model for URM and female students Summary: 4 URM females and 1 non-URM female discussed this theme. The URM female students particularly identified with, and felt understood by their coach, and benefitted from discussions with their coach about how she managed her identity as a URM female in academic science and about how she maintained work-life balance. **Sample quote(s):** *"You as my coach are very inspiring because you know you're a wife, a mother, a woman of color, all these things … that was also very reaffirming" (Black female)* *You know, I felt like my mentor didn't understand me the way that you [the Academy] did. [The Coach] is also from [Country], so we might have some things in common ... [this] probably was part of the reason but I felt like she understood me and supported me more than my mentor did. (Hispanic female)*
4. Academy as a "safe place" ***Summary***: 2 non-URM females, 1 URM female, 1 non-URM male and 1 non-URM male discussed this theme. Because of the diversity in the Academy, and because the students were from different institutions to each other and their coach, and were often in different fields, these 5 students felt that

they were free to have the "difficult conversations" about race and gender in academic science that they couldn't in their home institutions.

"There's stuff that I say here that I would never say if I was even at my lab" (Black female)

"[I]t's very comforting to see such diverse perspectives and you know so many different backgrounds and discipline and like this to be a safe place … I'm so happy to see other people of color in one place doing the same thing that I'm doing." (Black female)

5. The usefulness of social science theories as lenses to understand graduate school

***Summary**:* 3 URM females and 1 non-URM female discussed this theme. These students noted how the social science theories discussed in the Academy were new to them and gave them a new language and concepts through which to interpret their experiences, relationships and interactions in graduate school.

Sample quote(s):
"I think they [the theories] gave me the definition to explain what was going on in my life. …The idea that the PIs like to replicate themselves … I have been noticing it more after I learned the term" (Asian-American female)

6. Positive impact on perceived achievability
Summary: All 9 students discussed this theme. The students felt that the Academy helped to motivate them and enhanced their confidence about achieving an academic career. It helped them to acquire the knowledge of what is required in order to be successful in an academic career, and to reflect on their potential to achieve one.

Sample quote(s):
"I just feel rededicated to my purpose I guess by being here [in the Academy]. … I was strong but I'm even stronger because I'm equipped with tools to get things done" (Black male)

Table 4: Descriptive statistics for perceived achievability and desirability of an academic career

Group	Sub-group	Year	Mean (S.D.)	Change score	N
Achievability					
Academy	Female	2012	5.78 (2.26)		23
		2013	6.43 (2.27)	+0.65	23
	Male	2012	5.69 (2.46)		13
		2013	6.31 (2.25)	+0.62	13
	URM	2012	6.17 (2.23)		18
		2013	7.06 (2.18)	+0.89	18
	Non-URM	2012	5.33 (2.35)		18
		2013	5.72 (2.14)	+0.39	18
	Total	2012	5.75 (2.30)		36
		2013	6.39 (2.23)	+0.64	36
Control	Female	2012	7.10 (2.36)		21
		2013	6.48 (2.82)	-0.62	21
	Male	2012	5.87 (2.17)		15
		2013	4.87 (2.72)	-1.00	15
	URM	2012	7.00 (2.65)		9
		2013	6.33 (3.08)	-0.67	9
	Non-URM	2012	6.44 (2.31)		27
		2013	6.05 (2.28)	-0.39	27
	Total	2012	6.58 (2.34)		36
		2013	5.81 (2.86)	-0.77	36
Desirability					
Academy	Female	2012	7.17 (1.47)		23
		2013	6.61 (2.43)	-0.56	23
	Male	2012	6.69 (2.13)		13
		2013	5.92 (2.41)	-0.77	13
	URM	2012	7.17 (1.82)		18
		2013	6.67 (2.57)	-0.50	18
	Non-URM	2012	6.83 (1.65)		18
		2013	6.06 (2.28)	-0.77	18
	Total	2012	7.00 (1.72)		36
		2013	6.36 (2.42)	-0.64	36
Control	Female	2012	7.24 (2.57)		21
		2013	6.38 (2.67)	-0.86	21
	Male	2012	8.60 (0.83)		15
		2013	5.40 (2.16)	-3.20	15
	URM	2012	6.89 (2.76)		9
		2013	6.33 (3.04)	-0.56	9
	Non-URM	2012	8.15 (1.68)		27
		2013	5.85 (2.33)	-2.30	27
	Total	2012	7.83 (2.04)		36
		2013	5.97 (2.49)	-1.86	36

Table 5: Repeated-Measures ANOVA results for perceived achievability and desirability of an academic career

Outcome measure	**Factor(s)**	***F***	***p***
Achievability	Study group	0.002	0.97
	Gender	2.104	0.15
	Time	0.114	0.74
	Study group x gender	1.547	0.22
	Study group x time	7.707	0.017**
	Gender x time	0.161	0.69
	Study group x gender x time	0.110	0.74
Desirability	Study group	0.470	0.50
	Gender	0.203	0.65
	Time	29.542	<0.001**
	Study group x gender	0.658	0.42
	Study group x time	7.663	0.007**
	Gender x time	6.237	0.01*
	Study group x gender x time	4.367	0.04*

*P < 0.05 **P < 0.01

Supplementary Digital Content

Appendix 1: Four social science theories that underpin coaches' training

Theory	Key themes
Identity Formation [15-17]	*Stereotype threat*: Where concerns over confirming a negative stereotype cause anxiety and thus affect performance, e.g. test performance, working memory. This can play a particular role for URM and female scientists. *Self-recognition:* Where an individual needs to understand how their identity as a scientist may interact with their other identities, including gender and race/ethnicity. *Cultural code-switching:* Where individuals have to reconcile potentially conflicting identities in different contexts and social settings, in order to "fit in". *Recognition by others:* Individual's self-recognition can be affected by the extent to which others, e.g. mentors, see them as a scientist.
Social Cognitive Career Theory [16,18]	*Self-efficacy:* The extent to which an individual believes in his or her ability to successfully perform career-relevant specific tasks and objectives. *Vicarious learning:* Where an individual learns from watching the positive or negative outcomes of the actions of others. *Outcome expectations:* where decisions are informed by an individual's understanding of the potential outcomes of that decision. Teachers and mentors are important resources in providing accurate information about potential outcomes.
Cultural Capital [19-21]	*Cultural Capital:* non-economic assets that create social hierarchies and enable social mobility. The three types of cultural capital are: embodied (e.g. communication skills), objectified (e.g. academic/scientific books) and institutionalized (e.g. academic degrees) *Field:* Any structure of social relations, e.g. an academic discipline or a scientific society, within which there is conflict and negotiation concerning what constitutes legitimate cultural capital. *Habitus:* The sum of dispositions and behaviors that exemplify a particular social role or identity (e.g. the behaviors or dispositions of a physician or scientist).
Communities of Practice [22-23]	Situated Learning: Where learning takes place in the same social context within which it is applied. *Domain*: The shared interest or objective of the community, to which collaborative activities are oriented. *Legitimate peripheral participation:* where newcomers start by taking lower risk projects or tasks but ones that contribute to the shared goals of the community.