The Influence of Student-Faculty Interactions on Post-Graduation Intentions in a Research Experience for Undergraduates (REU) Program: A Case Study

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Abstract

Using a case-study approach, this research study examined how variability in the quality of student-faculty interactions during a summer research program for undergraduates at a public university influenced students' graduate school intentions. Three student-generated artifacts and one-faculty generated artifact were used to collect data for the study. Using different points in time to capture student-centered data and faculty-centered data, a snapshot emerges of the perceived student gains as an outcome of the student-mentor relationship. Social cognitive theory provided the framework to aggregate the data into meaningful units. The patterns emerging from the data were organized into three participant behavioral categories: positive student-faculty interaction and reinforced intentions or motivation to continue on to graduate school *(first category)*; positive student-faculty interaction and undecided graduate school intentions *(second category)*; and negative student-faculty interaction and no/graduate school intention *(third category)*.

Background

The University of Central Florida (UCF) is a public, research university, ranked second in terms of student enrollment in the United States. The Nanoscience and Technology Center (NSTC) and the Advanced Materials Processing Analysis Center (AMPAC) at UCF offer a summer Research Experience for Undergraduates (REU) program in "Hard and Soft Materials In Nanoscience Technology Driven Energy Applications." This is a ten-week research program funded by a grant from the National Science Foundation. Students learn to manufacture and study new functional nanomaterials and devices for energy applications and technology commercialization of nanomaterials under the guidance of faculty and graduate students from multidisciplinary programs (engineering and sciences). As part of the Materials Genome Initiative, various experimental research modules are paired up with computer-based modeling. Qualified students are selected from the applicant pool based upon academic merit, personal references, and suitability for the program. Eligibility requirements for the program are: U.S. Citizens and permanent residents; juniors and seniors majoring in Mechanical Engineering, Materials Science and Engineering, Electrical Engineering, Engineering, Physics, or Chemistry; and a GPA of 3.5 or higher. Selected students are provided a $4,500 stipend, travel expenses, and housing. This REU program has evolved over the years at UCF, focusing on undergraduate research and education experience in nanotechnology by the principal investigators. [1,2,3,4]

The purpose of our study was to better understand how variability in the nature and quality of the student-faculty interaction in the REU affects students' graduate school intentions (the program outcome). There is little research that investigates contextual factors within the mentoring

relationship that contribute to a student's decision to continue on to graduate school or not. The study contributes to the existing body of research on REUs by expanding our understanding of the character and significance of the gains experienced by REU students in relation to the quality of the experience. The results of our study can inform REU practitioners how to better structure and tailor the REU to meet the psychosocial needs of the student.

Research Experiences for Undergraduates

Studies on the benefits of research experiences for undergraduates (REUs) have shown that REU participants are more likely to indicate graduate school intentions[5,6] and to continue on to graduate school[7] compared with non-participants. Male and female REU students show the same level of interest in continuing on to graduate school.[5,8,9] Undergraduate research participants report their faculty mentor as being highly influential in their decision to continue on to graduate school or in their career choice compared with non-participants.[10] The primary motivation for faculty who mentor undergraduate researchers is to have a positive impact on the careers of talented students[11].

REUs provide student interns a pathway to explore their sense of "becoming a scientist" and to establish a career identity which is often inextricably bound up with personal identity.[12] The most frequent student-reported gains of participating in a REU are in the areas of increased confidence, personal/professional gains, "thinking and working like a scientist," improvement in various skills, clarification or confirmation of career and educational plans, enhanced career and graduate school preparation, and collegial working relationships with faculty mentors.[13,14] While increased self-confidence is often cited in studies as a benefit reported by REU students, some gender differences are apparent on particular research skill sets. A study by Kardash[15] showed that male undergraduate research interns rated themselves significantly higher at the end of the REU on their ability to understand contemporary concepts in the field and somewhat higher (marginally significant) on the ability to form research hypotheses than female interns. In the same study, Kardash[15] found agreement between mentors' and students' ratings on a set of research skills, with the exception of a significant difference for female REU students who rated themselves higher than their mentors in their ability to use scientific research literature.

Theoretical and Conceptual Framework

The cognitive apprenticeship model is grounded in social learning theories.[16] Social learning theory builds on earlier traditional learning theories by proposing that individuals also learn through observation and modeling, not solely through stimulus-response behaviors.[17] Bandura[18] later expanded the definition of social learning theory, which he renamed social cognitive theory, to include outcome expectations (expected consequences of a particular behavior), self-efficacy (confidence about being successful at a task), and goal setting (identifying a desired outcome). The cognitive apprenticeship model is characterized by expert guidance provided by a mentor to the novice in an authentic task or setting within a community of practice.[16] This model differs

from the traditional apprenticeship model by (a) allowing the objectives of the learning assignments to dictate the types of tasks given to students rather than the demands of the workplace; and (b) decontextualizing knowledge so that it can be applied in diverse settings rather than a specific setting.[19] Observation of the expert helps the novice to develop a conceptual model of the task which provides a useful framework within which the novice can organize, interpret, and reflect on feedback from the expert.[19] The apprenticeship model is the core of the undergraduate research experience, whereby a faculty researcher mentors an undergraduate student through hands-on, authentic, self-directed scientific investigation that makes an original contribution to the field.

Out-of-class experiences are as equally effective as class-related experiences on improved educational outcomes, suggesting that a holistic approach fosters students' college success.[20] Extra-curricular opportunities for undergraduate students to be involved in faculty-mentored research can be found on many campuses, an outcome of the Boyer Commission report[21] which recommended that research-based learning for undergraduates should be a standard in American research universities. Student- faculty interaction is an important factor in college student persistence[22] and student development.[23] The frequency of student-faculty interactions is more important than the contact time spent during these interactions.[24] Informal student-faculty interactions that involve intellectual or course-related discussions contribute to college persistence and positive educational outcomes.[25,26] Social interactions such as lunches, lectures, and banquets designed to encourage student-faculty interaction are less effective strategies.[27,28] Thus, the quality and type of the student-faculty interaction are important factors in student learning.[27,29]

Methodology

During Summer 2012, eleven students (7 men, 4 women) from nine universities participated in a ten-week REU program. Five students (45%) were from an under-represented group. Data were collected from three student-centered artifacts and one faculty-centered artifact. The student-centered artifacts were: a reflection paper on the experience (week 5); an exit satisfaction and future plans survey (week 10); and a follow-up survey (two semesters later, end of Spring 2013). Students were given an explanation of the research study for the reflection paper (*artifact 1*) as approved by the university's Institutional Review Board (IRB). The faculty artifact consisted of a pre-questionnaire (week 2) and post-questionnaire (week 8) rating students' knowledge, skills, abilities, and attitude.

Student Artifact 1 (Reflection Paper). In the reflection paper, nine questions were provided to guide the student to reflect on their experiences within the program.

The nine questions were:

1. Describe your research project and your role in the project.
2. What did you expect to get out of this research experience?

3. How has this research experience met your expectations?
4. What have you learned, and how did you learn it?
5. What part of this research experience helped you to learn the most?
6. What resources (people or reference resources) did you use in your research team, or did you find on your own to learn about your research project?
7. What was the most rewarding experience?
8. What was the most frustrating experience?
9. What is your dream job?

Student Artifact 2 (Exit Survey). The exit survey contained two sets of questions. One set of questions asked about satisfaction with various aspects of the REU; the second set of questions asked about the student's future plans. Responses relating to satisfaction with the program (responsibilities and expectations clearly presented; mentor available for consultation at pre-arranged times; conducive environment that facilitates learning; training and assignments effective and relevant to my career goals; adequate feedback received on my progress; lab facilities state-of-the-art) provided contextual details. Responses relating to future plans, specifically the question on graduate school intentions were collected for this study (" Before you began this REU, did you have intentions to continue on to graduate school? How has this experience changed your plans?").

Student Artifact 3 (Follow-Up Survey). The success of a REU program is typically characterized by the number of students who continue on to graduate school in the discipline or related discipline. The follow-up survey was emailed to each student at the end of Spring 2013. The six questions posed were:

1. Have you graduated? What major and degree?
2. Are you still enrolled? What major and degree?
3. Are you employed in a STEM job? Company name, location, job title?
4. Have you been accepted to graduate school? University name, major, and degree, start semester/year?
5. Have you received any awards, fellowships, etc.? Other accomplishments that you would like to share?
6. How have you used the knowledge and experience gained from your participation in the REU last year?

Faculty Artifact 1 (Pre- and Post-Questionnaire). Faculty mentors were asked to complete a pre-questionnaire in week 2 and the same post-questionnaire in week 8 of the experience. The questions were developed by the authors of this paper based on their experience with REUs. This questionnaire asked faculty to rate students' knowledge, skills, abilities, and attitude (see Table 1) on the assigned research project on a 5-point, Likert-type scale (5 = Excellent, 4 = Above Average, 3 = Average, 2 = Below Average, 1 = Poor, 0 = Not Observed).

Table 1. Pre-Post Faculty Questionnaire Rating Students' Knowledge, Skills, Abilities, Attitude

Breadth of Knowledge and Ability to Apply Knowledge
Quality of Oral Expression
Quality of Written Expression
Ability to Work with Others
Ability to Organize
Problem-solving Skills
Technical Skills
Professionalism
Motivation (Interest)
Resourcefulness (Initiative)
Ability to formulate own research question
Knowledge of how to do a literature review
Proficiency in performing assigned tasks
Skill in using tools and technology in the lab
Other (write here) _____

Data Analysis Approach. Students were instructed to turn in the reflection papers (*artifact 1)* to a staff member or the REU program director. The student papers were then forwarded to one of the co-authors (the researcher for this study), trained in qualitative research, for analysis. The exit surveys *(artifact 2)* were collected directly from the students by the researcher, as was the follow-up survey two semesters later. The researcher and a graduate student majoring in Mental Health Counseling, from the Counselor Education master's program in the College of Education and Human Performance, analyzed the text using a categorical aggregation approach of the case study method.[30] In the categorical aggregation approach, the researcher searches for examples from the data that are meaningful to the central purpose of the research. The researcher seeks to establish patterns between multiple categories emerging from the data. Albert Bandura's social cognitive theory [18,31] provides the framework to aggregate the data into meaningful units. Social cognitive theory has been successfully used in many fields to investigate the interaction of human behavior and the environment. The concept and definitions framework below (see Table 2) is adapted from the discussion of social cognitive theory in the successful promotion of healthy practices such as dietary change and pain control.[32] In this study, the authors have tailored these constructs to specifically apply them to the REU participant behavior in terms of the purposeful program outcome – to encourage participants to continue on to graduate school.

Table 2. Application of Social Cognitive Theory (SCT) Constructs to REU Participant Behavior

SCT Concept	SCT Definition	Application to REU
Reciprocal Determinism	Change in behavior resulting from person-environment interaction	Did the experience change the participant's graduate school intentions in a positive or negative way? Or was there no change?
Behavioral Capability	Knowledge and skills to influence behavior	What skills did the participant learn?
Expectations	Beliefs about results of behavior	Did the participant have prior expectations about the REU?
Self-Efficacy	Confidence about being successful at a future task	What personal goals did participants report achieving? (Responses limited to reported self-confidence on current tasks in the REU in this study.)
Observational Learning	Learning through observation of role model	Did participants interact primarily with faculty and/or graduate student mentors?
Reinforcement	Responses to a person's behavior that can increase or decrease the chances of recurrence	Was the behavior of the mentor(s) perceived as positive or negative by the participant?

Limitations of the Study

This study is based on a small sample size of students. The issue of generalizability is of concern with the case study method which is counteracted by the strength of the method, namely the ability to identify idiosyncratic characteristics in the research context.[33]

Results

Table 3 shows each case, representing an REU student, and the outcome of their interaction with their mentors and the research environment ("what it means to think and work like a scientist"). In Table 3, the column category "Self-Confidence" is defined as students' self-reported confidence on personal goals achieved (or not) in the REU. Patterns emerging from the data were captured at different points in time and organized within three participant behavioral categories.

Positive Experience With Mentor(s) and Graduate School Intentions (Behavioral Category 1). Over half of the students (6 of 11 or 54%) reported positive interactions with their mentors and graduate school intentions. Positive experiences reinforce and increase the chance that a student will be motivated to continue on to graduate school. Two examples of reinforced or enhanced graduate school intentions are: case #2 was interested in pursuing a master's prior to the REU but a PhD after the REU; and case #3 had "no clue" what graduate school was like before the REU but was now motivated to pursue graduate school after the REU. All six students (cases #2, 3, 4, 7, 8, 11) were satisfied with the assigned tasks and were confident about what they had learned in the process of "thinking and working like a scientist" such as being able to conduct an experiment, performing a literature review, and feeling better prepared for graduate school. These reported gains are consistent with the findings in the literature.[13,14] On pre- and post-questionnaires rating students' knowledge, skills, abilities, and attitude, overall mentor scores were: pre-mean = 4.17 (std = 0.98, n = 6), post-mean = 4.33 (std 1.03, n = 6).

Two-thirds (4 of 6 or 67%) identified a graduate student(s) as their supervisor, and the rest (2 of 6 or 33%) identified both the faculty mentor and graduate student(s). Two students (cases #4 and 11) reported dissatisfaction with an aspect of the mentoring experience. Cases #4 and #11 thought that responsibilities and expectations were not clearly presented, and Case #4 indicated that adequate feedback was not received on progress. In both cases, the participants reported being given a lot of leeway to work independently and overall positive interactions with their mentor. This finding suggests that being able to figure things out on their own gave them the self-confidence needed to complete the tasks and handle ambiguity, without over-reliance on mentor feedback.

On the follow-up survey question relating to graduate school acceptance, of the two (of six) students who had graduated, one had continued on to graduate school at the home university, and one was seeking employment in research work at an overseas university, with a goal of continuing on to graduate school upon return back to the United States. The remaining four students were still enrolled. Five students (one student did not respond to the survey within this group) indicated they had continued to apply the research skills and knowledge gained through the REU in lab courses or by participating in research at their home institution or another university within their home city.

Positive Experience With Mentor(s) and Undecided Graduate School Intentions (Behavioral Category 2). Twenty-seven percent (3 of 11) of the students were undecided about continuing on to graduate school prior to the REU and were still undecided after the REU. Their behavior was classified as "neutral." The three cases that fell into this category were cases #5, 6, 9. Similar to the students in group1 above, all three students had positive experiences with their mentor(s), were satisfied with the assigned tasks, and were confident about what they had learned in the process of "thinking and working like a scientist." One student identified a graduate student as their supervisor; the second, the faculty and graduate student; and the third, the research team (but did not specify the members of the team). Like group 1, the mentors consisted of both

faculty mentors and graduate student mentors. On pre- and post-questionnaires rating students' knowledge, skills, abilities, and attitude, overall mentor scores were: pre-mean = 4.33 (std = 0.58, n = 3), post-mean = 5 (n = 3). These mean scores are higher than the mentor scores for the group 1, suggesting that the students in this group are equally, if not more capable of conducting research as defined by the assigned research project.

The biggest difference between group 2 and group 1 seemed to be the dissonance between the type of career that the student envisioned and the research project assignment. On the satisfaction exit survey, two students (cases #6 and 9) expressed dissatisfaction with an aspect of the REU, namely that the training and assignments were not effective and relevant to the student's career goals. It should be noted that for case #6 that the student's dream job is to "build things;" similarly, for case #9, the student's dream job is to "work on the production of something in a factory setting" (see Table 3). This finding suggests that these students do not connect the research experience as a direct path to their dream job. For case #5, the student's dream job is to start a R&D nanotechnology company. It is not clear why this student was not more decisive about graduate school intentions after the experience; it may be that the student is also ambivalent about the dream job.

Theories on identity formation and career development may explain the undecided status of group 2 in terms of graduate school intentions both before and after the REU despite the positive experience with their mentors. In a study of college students, Blustein, Devenis, and Kidney[12] found that college students who were in the process of self-exploration (*moratorium status)* or had already committed to an identity having completed a self-exploration period (*identity achievement)* were more likely to be active in career exploration than those who lacked self-exploration and identity commitment (*diffusion status).* Identity achievement was strongly correlated with exploratory activity.[12] Group 2 students may have been less further along the continuum of the self-exploratory process than group 1 students and may have been more open to experimentation, even if the activity did not align with their "dream job."

On the follow-up survey question relating to graduate school acceptance, one student had graduated and had applied to several graduate schools (but no acceptance as of yet). The remaining two students were still enrolled. One student replied that they had not used the research skills learned in the REU as of yet, and the other student had applied the research knowledge learned in the REU in classes that involved this topic. The third student responded having used the research skills and knowledge learned in the REU but did not specify how. As expected, group 1 was more active and motivated to continue to apply the skills and knowledge gained through the REU compared with group 2.

Negative Experience With Mentor(s) and No or Graduate School Intentions (Behavioral Category 3). Eighteen percent (2 of 11) of the students reported negative experiences with their mentor(s). Both students were women. One indicated graduate school intentions prior to the REU, but was no longer interested in graduate school after the REU (case #1). This student's

behavior was classified as "negative." The second student (case #10) indicated graduate school intentions prior to the REU, which was reinforced through participation in the REU. This student's behavior was classified as "positive." Both case #1 and case #10 reported frustration and disappointment with the lack of control over the assigned tasks and with the mentoring experience (inconsistent supervision, under-supervision, or over-supervision). The difference between case #10 (behavior classified as "positive) and case #1(behavior classified as "negative) may be attributed to how each student dealt with uncertainty. Case #10 reported that the main purpose for choosing this research area was to operate out of her comfort zone, which suggests that the student was able to tolerate the lack of control over the assigned task because of her pre-conceived expectations. Case #1, however, expressed dissatisfaction with every category of the experience in the exit survey. She described her assigned project as ill-defined and consisting of very basic tasks. The uncertainty and lack of support was demotivating. She had learned that she needed to be more assertive the next time. Case #1 was also placed with a male student (case#3 who reported positive experiences) under the same mentors. It is interesting to note that both case #1 and case #3 reported that their "dream job" was to be a college professor. While case #1 had prior intentions to continue on to graduate school but was demotivated by the REU, case #3 had no prior intentions to continue on to graduate school but was motivated to do by the REU. It is possible that their mentor(s) (the students mention having more than one advisors) may have had pre-conceived, gender-based expectations. There is some evidence that gender differences play a role in self-ratings or ratings by the mentor on research skill sets.[15]

On pre- and post-questionnaires rating students' knowledge, skills, abilities, and attitude, overall mentor scores were: pre-mean = 3.5 (std = 0.71, n = 2), post-mean = 4.5 (std = 0.71, n = 2). Group 3's pre-mean score was lower than groups 1 and 2, and post-mean score was higher than group 1 but lower than group 2. These ratings suggest that group 3 was at least equally capable of performing research tasks at the end of the REU as groups 1 and 2 and as defined by the assigned research project.

On the follow-up survey question relating to graduate school acceptance, case #1 did not plan to apply to graduate school. However, despite her negative experience in the REU, it had not detracted from her perception that REUs provided valuable benefits. Working in the lab during the REU had given her more confidence to interact with professors and faculty at her home institution. The student also encouraged other girls at her home institution to take advantage of the opportunities that REUs offer. The second student (case #10) had graduated and had enrolled as a non-degree seeking student at the home institution.

Pre- and Post-Questionnaires (Faculty Ratings of Students in Groups 1, 2, and 3). Overall student performance (all three groups) increased from a mean of 4.09 (std = 0.83, n = 11) to 4.55 (std = 0.82, n = 11) over the six weeks between the administration of the pre- and the post-questionnaire. Students showed most improvement in the areas of application of knowledge, tools and technology, problem-solving and technical skills, and performance on tasks. Being able to formulate their own research question and being resourceful were the areas in which students

could use the most improvement. Given that the summer REU experience lasts only ten weeks, these two areas may require students to spend a longer period of time in performing undergraduate research to fully develop these skills.

Table 3. Participant Behavior in the REU Explained Through the Lens of Social Cognitive Theory (SCT) Constructs

Case #	Reciprocal Determinism	Behavioral Capability	Expectations	Self-Confidence	Observational Learning	Reinforcement	Career and Graduate School Intentions
1 Prior research exp.	Behavior (-)	Lab techniques, protocols, behavior, and safety	No	Frustration and disappointment (research goals not clearly defined; inconsistent support)	Observed advisors	Negative (-)	Dream job was to be a college professor. Interested in graduate school before the REU, but now does not think will continue on to graduate school.
2 No prior research exp.	Behavior (+)	Perform set of experiments	Yes	Patience, independence, hard work	Collaborative learning (graduate student, group meetings, weekly lectures from other faculty)	Positive (+)	Dream job is to work in industry. Interested in pursuing Master's before the REU but now motivated to pursue PhD because of REU.
3 No prior research exp.	Behavior (+)	Use various instruments and learned new subjects	No	Confidence to "self-teach"	Advisors very helpful in learning process (graduate student mentors)	Positive (+)	Dream job is to be a researcher or college professor. Did not have a clue what graduate school was like before the REU, but because of the REU would like to go to graduate school.
4 No prior research exp.	Behavior (+)	How to quickly and efficiently find literature to help guide the research	Yes	Confidence in feeling better prepared for graduate school	Learned great deal from mentors (faculty and graduate student) but most from the literature review	Positive (+)	Dream job is R&D work in industry. Had graduate school intentions before the REU, the REU reinforced this.
5 No prior research exp.	Neutral	Lab experience, meeting deadlines, learn new subjects	Yes	Hands-on experience and theoretical training	Mentors (faculty and graduate student) very involved in directing the student	Positive (+)	Dream job to is own a R&D company. Sort of thinking about graduate school before the REU, and nothing has changed because of the REU.

Case #	Reciprocal Determinism	Behavioral Capability	Expectations	Self-Confidence	Observational Learning	Reinforcement	Career and Graduate School Intentions
6 No prior research exp.	Neutral	How to conduct scientific research	Yes	Motivated to learn on own	Research team	Positive (+)	Dream job is to build things. Undecided about graduate school before the REU, and nothing has changed because of the REU.
7 No prior research exp.	Behavior (+)	Use equipment unfamiliar with, learn about new subjects, decide what track in major to pursue	Yes	Skills gradually becoming second nature; gradually worked on own. Praise from faculty mentor rewarding.	Mentors (faculty and graduate student)	Positive (+)	Dream job is applied research. Indicated graduate school intentions prior REU but is more motivated after the REU.
8 Prior research exp.	Behavior (+)	Become more familiar with the subject and be better prepared for graduate school	Yes	More control of project and exposed to wider variety of equipment than previous REUs	Mentor (graduate student) and literature review	Positive (+)	Dream job R&D for either a national lab or an industry leader. Indicated graduate intentions before the experience, and reinforced intentions.
9 Prior research exp.	Neutral	Better understand the nature of conducting research in preparation for graduate school	Yes	Reward is the experience itself	Mentor (graduate student) and literature review	Positive (+)	Dream job is working for a manufacturer. Undecided about graduate school before REU; still undecided.
10 No prior research exp.	Positive (+)	Get out of comfort zone in a different area to help decide track to pursue in graduate school	Yes	Frustration and disappointment (over-supervised and too many tasks in one day)	One-on-one interaction with mentor (faculty)	Negative (-)	Undecided on dream job. Graduate school intentions prior REU, and reinforced after.
11 Not known	Positive (+)	Lab experience and what a graduate student does	Yes	Nervous working in unfamiliar field curious about but learned a lot	Mentor (graduate student)	Positive (+)	Dream job is to be a professor. Graduate school intentions prior REU, and reinforced after but now open to different d fields.

Conclusion

The purpose of our study was to better understand how variability in the nature and quality of the student-faculty interaction in a summer REU program affected students' graduate school intentions (the program outcome). Within the framework of Bandura's social cognitive theory,[18] patterns emerged from our study that provided insights into contextual factors that contributed to a student's decision to continue on to graduate school or not. The preliminary results suggested that positive interactions with mentors led to reinforced or enhanced graduate school intentions (group 1); positive interactions with mentors did not have an effect on graduate school intentions for undecided students (group 2); and negative interactions with mentors was contextually dependent in terms of the student's motivation or demotivation to continue on to graduate school (group 3). In many instances, the graduate student mentor was the first-line supervisor. Insights gained from the study revealed that students who were given opportunities to work independently were better able to deal with uncertainty without over-reliance on mentor feedback; students who were not able to connect the type of career that they had envisioned with the assigned research project remained undecided about their graduate school intentions; and inconsistent supervision by the mentor and lack of control over the assigned research project may be a demotivating deterrent to graduate school intentions for female students. It was too early to determine if graduate school intentions converted to actual intentions. Four of the eleven REU students had graduated by the time of the follow-up survey two semesters later (the end of Spring 2013 semester), and one of the four had continued on to graduate school.

The following recommendations may be useful for REU practitioners to better tailor the REU environment to meet the psychosocial needs of the student: (1) provide students with the opportunity to work independently ("do not hover" but be available if needed); (2) ask applicants to describe their "dream job" (if they like to "build things," it may be better to match them with an applied research project); (3) implement a neutral feedback mechanism (e.g., students can talk or turn in a written reflective statement to a REU program staff), especially for female interns who may feel intimidated in speaking up; and (4) train graduate student mentors how to be a good mentor, as they are often the first-line supervisor. This study was based on a small sample size (n = 11 students). An additional 20 students will be recruited over the two remaining years of the REU program, which will provide a cumulatively larger sample to continue validation of the results of this study. A second follow-up survey asking about graduate school and employment status will also be sent in Spring 2014 to the Summer 2012 REU cohort.

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