An exploratory research study of Massachusetts Institute of Technology's Undergraduate Research Opportunities Program (UROP): The impact of student-supervisor relationships

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ABSTRACT

Massachusetts Institute of Technology's Undergraduate Research Opportunities Program has been around for over 30 years and is seen as "one of the most important means for students to foster mentoring relationships with faculty and research staff." By analyzing data obtained through semi-structured interviews and survey results, a typology of supervisors was formed to delineate whether students consider their UROP supervisor to be a mentor. Quantitative findings suggest that those who participate in UROP are only slightly more likely to find mentors at MIT when compared to those who had not participated in the program. Further secondary data analysis suggests that faculty interaction is a better variable to use (than UROP participation) when attempting to explain variation in whether students found mentors at MIT.

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Introduction and Rational

In 1969, the Massachusetts Institute of Technology founded the Undergraduate Research Opportunities Program. Known by most students today simply as UROP, it was designed to encourage students to work with MIT faculty on research based intellectual collaborations. It is thought to be and markets itself as one of the most important means by which students can foster mentoring relationships with MIT faculty and research staff. According to its website, approximately 80% of undergraduates participate in UROP at least once during their time at MIT (MIT 2004). Upon examining these claims it is natural to ponder whether such a program really is a vehicle for students to gain mentors or if UROP is just part of the story in terms of whether students develop positive student-supervisor relationships at MIT.

By examining MIT's UROP program and specifically focusing on student-supervisor relationships within the program and at MIT in general, a sense of whether students find mentors at the Institute can be determined. Mentors can play an important role in a student's life. They can assist the student in determining a course of study as well as with preparations for entering the workforce, which may include gaining job experience. By determining UROP's role in a student's quest to find a mentor, UROP can attempt to improve the quality of mentor relationships formed under its domain.

Research for this study included both qualitative semi-structured interviews from students who have participated in UROP, as well as secondary data collected from MIT's undergraduate student body. Using two forms of data will expand the knowledge base on UROP student-supervisor relationships by allowing for unanticipated responses that cannot be readily obtained

through a survey, as well as tangible quantitative results that can be generalized to the whole of MIT.

Literature Review

Throughout life's many stages exist many transition points. New parents often wish that babies were born with instruction manuals. As individuals grow and mature, there is unfortunately no formal instruction book on how to move from one stage of life to another. There is however the world around us that we can use as a model. Young children mimic their parents and role play with each other. They are often seen playing house or school and take on the role of mom or dad or teacher. As one grows older, the transition between adolescence and adulthood is much more complex and a guide to this transition can be helpful. A mentor can act as that guide. The mentoring process involves an intense interpersonal relationship and is seen as a means of enhancing the transition from adolescence to adulthood through the provision of support and challenge by individuals or groups (Philip and Hendry 1996). A mentor commonly refers to someone who advises, counsels, or helps (younger) individuals and is usually thought of as "an older, or senior, individual who is willing to give time, interest, and emotional support over an extended period" (Peluchette and Jeanquart 2000: 551) to further the advancement of a junior person or protégé (Eby et al. 2000). If the nature of a mentor and the mentoring process is understood then the effectiveness of programs that endeavor to cultivate mentor-protégé relationships can be explored.

Conceptual Framework

To understand some of the intricacies of the mentoring process, there must also be a basic understanding of human development and psychology. Individuals must be socialized into the world. The environment in which they exist has an impact on this development. "Nearly every

major school of sociological thought has emphasized, in one way or another, the uniquely 'open' or 'unfinished' character of the human organism in relation to its environment" (Dannefer 1984:107). In the past, an ontogenetic model to adult development was used which treated the individual as a self-contained entity that failed to "recognize the profoundly interactive nature of self-society relations and the complexity and variability of social environments" (Dannefer 1984: 100). Part of the responsibility of a mentor within a university setting is to socialize his/her protégé into the world post graduation. (Kram and Isabella 1985; Peluchette and Jeanquart 2000; Siebert 1999;).

Human psychology adds another dimension to the mentoring relationship. If it did not, all formal mentoring environments would result in successful pairings of mentors and protégés. Instead, a mutual affinity must be present between the pair. According to past research, "the degree of similarity between the mentor and the protégé, either actual or perceived, could affect the quality of the mentoring relationship. This phenomenon is explained by the similarity-attraction paradigm, which suggests that the more similar one perceives another person to be, the more that other person is liked"(Ensher and Murphy 1997:463-464).

Importance of mentors

Research indicates that mentored individuals establish professional networks, have more defined career aspirations, have improved self image (due to emotional support and counseling provided from the mentor), perform better on the job, advance more rapidly within an organization (i.e., get promoted more quickly and earn higher salaries), report more job and career satisfaction and express lower turnover intentions than their non-mentored counterparts (Ensher and Murphy 1997; Kram 1983; Peluchette and Jeanquart 2000; Seibert 1999; Wright and

Wright 1987). The benefits of mentorship can be categorized into two distinct arenas, professional development (career enhancement or advancement) and psychosocial support.

Professional development includes skill development and exposure to new ideas and concepts. It can also include sponsoring the protégé into a professional social network. In the academic community, mentor sponsorship can have important consequences. A phenomenon Merton (1968) referred to as the "Mathew effect," depends heavily on the past reputations of scholars in judging their current contributions. This past reputation takes into account professional credentials accrued which includes mentor scholarly stature (Sanders and Wong 1985). In addition, mentors often provide protégés with the opportunity to collaborate on research that can lead to co-authorship, thereby adding to a protégé's professional credentials (Long and McGinnis 1985).

"Psychosocial support includes those activities in which mentors serve as role models and provide counseling, coaching, friendship, confirmation, and acceptance. Psychosocial functions are believed to enhance a protégé's sense of competence, identity, and effectiveness in a role" (Ensher and Murphy 1997:461). Mentors can facilitate the development of new talents and provide acceptance and confirmation of the protégé's abilities, thereby increasing the protégé's self-confidence (Wright and Wright 1987).

Past research has outlined the importance of mentor relationships as well as different factors such as demographics that may impact the effectiveness of mentor relationships. Different settings in which mentor relationships are fostered, such as academia or a corporate environment have also been explored using a variety of methodological approaches including: interviews, surveys, focus groups and content analysis, along with a mixed methodological approach using quantitative data and content analysis. With this knowledge, a baseline is

established which can be used to explore the effectiveness of MIT's UROP program in terms of fostering mentoring relationships.

Methodology

UROP is a program that has been in existence at MIT for over thirty years but it is not a program that has been studied extensively. There are some preexisting data that examines UROP and student-mentor relationships but the data I had access to are very limited. A mixed methodological research approach allows analysis of current available data as well as inquiry into areas of interest previously unexplored. Coupling semi-structured qualitative interviews with preexisting quantitative data obtained increases the scope of knowledge that would have otherwise been available with current survey instruments.

Data Set and Study Participants

In the spring of 2003, MIT administered the Consortium on Financing Higher Education's (COFHE) Enrolled Student Survey over the internet to undergraduate students at the Institute. This survey includes a wide range of topics including time spent doing various activities and an assessment of whether students believed that their skills and abilities have changed since enrolling at MIT. The data set is a self-selected, non-probability sample that used cross sectional surveying with individuals as units of analysis. The overall response rate for this survey was 43% (1,762 responses).

From the list of students who completed the enrolled student survey, a sampling frame comprised of students who have participated in UROP and who completed the survey was selected as potential interview subjects. From the 1,738 survey respondents who said they either participated or did not participate in UROP, 1,080 or 62.1%, reported that they had worked on a UROP. In order to provide a cross section of responses from MIT's five different schools

(Architecture and Planning; Engineering; Humanities; Arts and Social Sciences, Sciences; Sloan School of Management), at least one student was randomly selected from each school using a random number generator to participate in semi-structured interviews to gain qualitative data to be analyzed.

The final student sample that was interviewed for this study included: two Architecture students; two Engineering students; two Humanities, Arts and Social Science students; three Science students and one student from the Sloan School of Management, for a total of 10 undergraduate students. The sample is comprised of 7 females, 5 seniors, 4 juniors, 1 sophomore, 4 ethnically white students, 2 students with an unknown ethnicity and 1 student each who considers him/herself as: Asian American, Other Hispanic American, African American or International. Each student interviewed had worked on at least 1 UROP, but some students worked on as many as 3 to 4 UROPs.

Qualitative Data Procedures

Once students were randomly selected, they were contacted either by email or the phone, and asked if they would consent to a short interview that would last no longer than an hour. The interview topic for this completely voluntary and confidential study was their UROP experience, with specific attention paid to the relationship they had with their supervisor. In exchange for agreeing to be interviewed, they would receive two free movie passes. If the targeted student consented, an interview appointment was set up. Most interviews took place in a semi private office space at the Institute, but students were given the option of being interviewed at a location in which they felt more comfortable or that was more convenient for them. Two students took advantage of this option and were interviewed at the student center in a public space.

At the time of the interview, students were reminded that all information they provided would be kept confidential and the interview was completely voluntary. An informed *consent to participate in non-biomedical research* form was introduced and explained to the student. Once all issues were addressed, the student was asked to sign the form and the interview began once I (the investigator) also signed the form.

The interviews for this study are based on a semi-structured interview script. The original framework of the questions was focused on the relationship students had with their supervisor and the impact the supervisor had on the student's development (academic/professional and personal). With experience, it was deemed necessary to include other topic areas in the interview, to get a better understanding of the student's UROP experience and what they gained from it, especially in terms of their relationship with their supervisor. Probing questions into topic areas such as: the UROP experience itself; thoughts on an ideal UROP (and supervisor); if they were to do another one in the future; recommendations for the program or 'words of wisdom' for someone who is looking for a UROP and whether they had mentor figures within the MIT community, but outside of UROP, were asked. The length of time for each interview ranged from 25 minutes to 1 hour and 10 minutes. While interviews were conducted, notes were taken by hand onto a small notepad. Once the interview concluded and the student departed with his/her movie passes, hand written notes were completed and transcribed.

Qualitative data outcomes measures

When all interviews were completed, they were reviewed and reoccurring themes and ideas that appeared in the transcripts that might shed light on how students benefited from their UROP experience and supervisor-student relationship within UROP were examined. Paying particular attention to similarities and differences that appeared in each interview, the data was

searched to determine what the main characteristics are by which students categorize their supervisors as either a supervisor (a superior person they report to) or a mentor (a senior individual who advises, counsels, support or helps a younger individual). Further examination resulted in the identification of three initial subcategories which are: UROP supervisor, UROP mentor and MIT mentor (outside of UROP).

Quantitative Data Outcome Measures

To further the study and determine if participation in UROP had any affect on whether or not students found mentors at MIT, data from the 2003 COFHE Enrolled Student Survey was also examined. The survey was selected because of the population it was administered to as well as the questions included in the survey. Questions on faculty interaction appeared as well as questions on UROP.

The enrolled student survey includes variables that measure the outcomes of UROP. Students were asked, "Which of the following were outcomes or consequences of your UROP participation?" (response options – not at all, to a slight extent, to a moderate extent, to a considerable extent, to a very good extent).

- Got to know the faculty
- Helped me understand the nature of research and experimentation in a particular discipline
- Helped me make or confirm my choice of major
- Exposed me to research outside my major
- Provided me with opportunities to enhance my presentation skills
- Led to summer job

In addition, two indexes were created from the Enrolled Student Survey to measure interaction with faculty and whether students relied on faculty for academic and professional advice which was used as a proxy to determine if students had found mentors within the Institute. These two indexes were also used to help determine the validity of these measures using a construct validation approach. To assess the reliability of these indexes, Cronbach's alpha was calculated.

Index Construction. The first index measuring whether students relied on faculty for professional/academic advice was comprised of sixteen items. The response options for each of these dichotomous variables are based on 'check marks' in a response matrix (See Figure 1). By counting 'yes' responses, the index averaged the number of students who relied on the given individuals for advice.

Figure 1: Faculty Advice Index Variables

Indicate which of the following people you have relied on during the academic year for advice about (Mark all topics that apply for each person)

	courses	academic goals	research	career goals
Your academic advisor	(cadv01)	(acadv01)	(mit4)	(cradv01)
Faculty member who is not your academic advisor	(cadv02)	(acadv02)	(mit5)	(cradv02)
Department chair	(cadv03)	(acadv03)	(mit6)	(cradv03)
Academic dean	(cadv04)	(acadv04)	(mit7)	(cradv04)

(variable name)

The alpha value for this first index is 0.6952.

In addition, the inter item correlation matrix (see Table 1) for the variables within the faculty advice index show that there is a higher correlation between variables that correspond to

the same individual on the faculty. This indicates that students are more likely to seek a particular individual consistently, rather than seek out advice from a myriad of individuals.

Table 1: Faculty Advice inter item correlation matrix

	CADV01	CADV02	CADV03	CADV04	ACADV01	ACADV02	ACADV03	ACADV04	MIT4	MIT5	MIT6	MIT7	CRADV01	CRADV02	CRADV03
CADV01	1.0000														
CADV02	.1473	1.0000													
CADV03	.0412	.1397	1.0000												
CADV04	.0332	.1162	.0591	1.0000											
ACADV01	.4318	.1571	.0813	.0444	1.0000										
ACADV02	.1219	.4801	.1191	.0775	.1236	1.0000									
ACADV03	.0534	.1083	.5491	.0258	.0984	.1310	1.0000								
ACADV04	.0381	.0737	.0192	.6267	.0671	.0816	.0967	1.0000							
MIT4	.1368	.1184	.0174	.0024	.2279	.0557	.0264	.0156	1.0000						
MIT5	.0940	.2593	.0980	.0280	.0894	.3834	.0784	.0190	.1506	1.0000					
MIT6	-.0223	.0635	.2656	.0776	.0339	.0418	.2400	.0733	.0724	.1268	1.0000				
MIT7	-.0251	.0189	-.0191	.2406	-.0117	.0378	.1117	.2315	.0548	.0276	.2439	1.0000			
CRADV01	.2042	.1496	.0729	.0512	.4101	.1812	.0811	.0343	.3474	.1813	.0627	.0091	1.0000		
CRADV02	.0831	.3802	.0662	.0634	.0871	.5391	.0550	.0779	.1051	.4277	.0667	.0531	.2100	1.0000	
CRADV03	.0025	.0998	.4773	.0024	.0621	.1093	.4792	.0006	.0259	.0909	.2879	-.0135	.1161	.1121	1.0000
CRADV04	.0280	.1081	.0319	.3675	.0369	.1030	.0356	.5145	.0402	.0646	.0352	.2234	.0342	.1290	.0077

The second index measured how often during the academic year, did students and faculty interact. Five items were included in this index. Those items are:

- Discussed career with faculty (fac4)
- Discussed academic work with faculty (fac2)
- Discussed course selection with faculty (fac1)
- Had an intellectual discussion with faculty (fac23)
- Interacted with faculty at a social event (fac6)

Each item had a four point response scale that ranged from never to very often. The index was then constructed by averaging the responses for these variables. This index had an alpha value of 0.8406. The inter-item correlation matrix (see Table 2) indicates that all items in the index are at least moderately correlated.

Table 2: Faculty Interaction inter item correlation matrix

	FAC4	FAC2	FAC1	FAC23	FAC6
FAC4	1.0000				
FAC2	.6466	1.0000			
FAC1	.5929	.6605	1.0000		
FAC23	.5263	.5112	.4709	1.0000	
FAC6	.4070	.4010	.3748	.5418	1.0000

Quantitative Data analysis

Preliminary examination of the frequency responses for the UROP variables in the Enrolled Student Survey gave an initial baseline to compare results from further data analysis. Secondly, by comparing mean responses in the two indexes (faculty advice and faculty interaction), from students who have participated in UROP and those that have not, one can further support whether participating in UROP really makes a difference in whether students have found mentors at MIT. This is because the faculty advice index will be used as a proxy to determine if students have mentors. Faculty interaction is perceived to be a variable that correlates with whether someone goes to faculty for advice, but it is not necessarily a causal relationship due to the fact that interaction does not take into account how an individuals feels or perception of the relationship with a supervisor/potential mentor. For example, someone may be in close contact with a supervisor due to the nature of their work, but this does not mean that they are comfortable with seeking professional development advice from that individual.

In addition, a regression analysis was conducted to see if UROP participation is a good predictor of finding mentors at the Institute, when demographic variables such as: gender, grade point average, class year, ethnicity and highest degree of mother and father, acted as controls. Because UROP participation is voluntary, demographic variables are used to help dispel the notion that some extraneous demographic variable is the causal factor to whether a student participates in UROP and find mentors at MIT. Lastly the faculty interaction index was added to

the regression model to see which variable – UROP participation or faculty interaction – was a better predictor of whether students found mentors at MIT.

Limitations

The weaknesses of this study must be addressed. By using a semi structured interview script for the qualitative segment of this mixed methodology approach, the same set of questions were not consistently asked. While certain core themes and questions were consistently touched upon, other themes and pertinent topics began to appear as the study continued which meant that additional probing questions were asked of later interviewees, when compared to those conducted earlier in the study. Due to the very nature of qualitative research, findings from data collected in interviews can not be generalized. My qualitative findings should be used to add some depth to one's knowledge about a students' relationship with their UROP supervisors.

In addition, the use of self reported measures, both in interviews and survey responses, may call into question the validity of responses. While self reported data was necessary due to time constraints in which interviews could be conducted and given the size of the undergraduate student body at MIT that was surveyed, one must be aware that biases or responses of questionable validity could be obtained because of selective student memory. Also, causal conclusions can not be established using the multiple regression analysis because variables that were not considered and went unmeasured could contribute to this self selection bias.

Findings

Findings result from both qualitative data collected and the quantitative data analysis.

Qualitative Data Findings

Characterizing UROP mentors versus UROP supervisors. The results of this study suggest that students who participate in UROP may have an environment that is more conducive

to forming mentoring relationships at MIT because more intimate contact is required when compared to a classroom environment, but mentoring relationships do not necessarily result from this collaboration. There are several key factors that determine whether students develop mentoring relationships through UROP. These factors include: amount of interaction between supervisor and student, UROP work environment, meaningfulness / ownership of actual UROP work, student assessment of whether they further developed in terms of skills or professionalism and student perception of the nature of their relationship with their supervisor.

Amount of interaction between supervisor and student. Students are assigned to particular faculty when they agree to participate in UROP. While there is no difference in this study with regards to whether students work with faculty or graduate/post doctorate students, in terms of supervisor/mentor categorizations, it is clear that some supervisors work more closely and have more regular interaction with UROP students. Students who met with supervisors one-on-one regularly were more likely to consider their supervisor to be a mentor. For example, one mentor went so far as entering the student's schedule into her own personal calendar, so she'd know where the student was on a regular basis. The student felt this gesture, along with their informal interaction and formal weekly meetings, kept her actively involved in the research which made her feel valued and indebted to the mentor.

Students who met with supervisors infrequently or had a mostly 'email' relationship with their supervisor were considerably less likely to consider their supervisor to be a mentor. One student revealed that though she had been working on her UROP for close to three months, she had yet to meet her supervisor in person. Another student revealed that during her UROP, her supervisor spent most of the term traveling and their only means of communication was via

email. This deficiency in interaction with supervisors is not conducive to developing mentor relationships with MIT faculty and research staff.

UROP work environment. Work environment, can be considered a broad, all encompassing category. For the purposes of this study, work environment is defined as a student's feelings toward the atmosphere that is present in their place of work. This includes whether students feel free to express their ideas as well as whether they know their role and are comfortable in the physical space they occupy during UROP (if applicable).

Students in a positive work environment more often viewed their UROP supervisor to be a mentor. Comments such as "he made work fun" or "he is my go to guy and I can talk to him about anything" were not uncommon. Alternatively, students who were unsure of their role on a research project, felt uneasy or were bored with their UROP, were likely to discontinue their relationship with their UROP supervisor and did not receive any benefits of mentorship. Work environment may be an indicator of other influential elements in terms of variables that impact the development of mentoring relationships which would require further future investigation.

Meaningfulness / ownership of actual UROP work. UROP, though it has a long history, is still relatively unstructured. Students use several avenues to find a UROP. Some UROP openings are posted on a website. Others are put onto a listserv that is emailed to students and news of some openings are passed through word of mouth. Proactive students look through websites and find a professor conducting interesting research and email professors or departments directly to find or create a UROP.

No matter how students find a UROP, students like to feel that their work is worthwhile. Those who feel as if they are doing 'grunt work' or they have no ownership of the research and are being micromanaged by a supervisor are less likely to report that they view their supervisor

to be a mentor. Students who work independently and feel as thought they can chart the direction of their research are more likely to report they found a mentor through UROP. For example, one student attended a conference that focused on research projects that faculty were involved with. Inspired by the conference, the student approached the faculty member to see if there was any way in which she could get involved with his research. The faculty advised her to develop a proposal in which the same technology was used in a different setting so he could advise her on her work, instead of have her focus on his work. This resulted in the expansion of the scope of research the professor was working on (because it could be applied to different settings) as well as a separate independent project for the student. Professor and student collaborated on a student's research project, not a professor's project. The advice and guidance given by the supervisor in this relationship resulted in the student feeling as though she found a mentor as well as a real learning opportunity.

Student assessment of whether they developed skills/professionalism during their UROP. UROP is touted as a program in which students are given the opportunity to work on "cutting edge" research and MIT is know throughout the world as a university with one of the best academic reputations. Students at MIT seek out opportunities in which they can learn new skills, be exposed to new ideas and try new things. A successful UROP provides an environment in which students feel they gain professional as well as skill development. While this category is highly correlated with UROP work environment and meaningfulness of UROP work, other factors are taken into consideration. For the purposes of this study, skills and professional development can be defined as exposure to new ideas, acquisition of new skills and knowledge (i.e. computer programs) and introduction into the professional world (i.e. social networking, publication, formal presentations, etc).

Students are more likely to view their supervisor as a mentor if they feel they have had some skill/professional development. One student when asked if she considers her supervisor to be a mentor gave an enthusiastic 'yes' response and said, "everything I learned about research biology I learned from her!" Another student discovered new ways of using pre-existing knowledge. The student discovered through his course of study that he did not want to work in his chosen major field of study. He used UROP opportunities to expose himself to areas of study that interested him, but weren't necessarily related to his course of study. He found a UROP and mentor that let him use the skills he had learned in class, in a new way that he found intellectually stimulating. This new professional path benefited from the professional development he received during UROP, using his old skills and the help of his mentor.

Student perception of the nature of their relationship with their supervisor. The final primary category that distinguishes a UROP supervisor from a UROP mentor in the eyes of students is based on the nature of the student's relationship with his/her supervisor. If students feel they have a more personal/social relationship with their supervisor, they are more likely to view them as a mentor. For example, if a student continues to have an active relationship with a supervisor outside of the workplace or after the formal work relationship is over, then they are more likely to call their supervisor a mentor. Mentors are seen outside of the workplace. They invite students to parties and have lunch with their protégés on occasion. They may send a student a birthday card or forward an article that they think the student might be interested in reading. It tends to be a comfortable relationship in which a mutual respect exists as well as general concern for the interests and the well being of the protégé.

Authoritarian relationships are less likely to produce mentor-protégé relationships. Some students revealed they respect and admire their UROP supervisor, but are intimidated at the same

time. They see their supervisor as a 'boss', not a friend they can confide in and seek advice from. One student thought her supervisor was a 'genius' but was intimidated because her supervisor was so smart and had such high expectations.

Characterizing UROP mentors versus MIT mentors

To further examine whether or not students found mentors at MIT, students were asked if they had found mentors at MIT that were not associated with their UROP experience. More than half of the students interviewed responded that they did indeed have mentors at MIT outside of UROP. The main traits that MIT mentors shared included the openness/supportiveness of the relationship and the personal/social connection shared with the mentor. These characteristics correspond to the work environment and the perceived nature of the relationship examined above when characterizing UROP mentors versus UROP supervisors.

Students/protégés felt that they could talk to their MIT mentors about anything and they could seek advice from them. For example, one student failed a class during his freshman year, but found that he could connect to that professor. He retook the class with that professor and has since kept in touch with his mentor. Recently, while the student had an informal meeting with his mentor, the conversation turned into a passionate discussion about science (the field of study the student failed). Near the conclusion of the discussion the mentor said something along the lines of "wow, you're really interested in this stuff…you sucked at science but you really like this stuff." It was something said without malice because of the openness of their relationship.

Personal/social connection to a mentor was the second key factor that induced a student to consider someone a mentor. Students repeatedly saw mentors as friends or parental figures despite the fact that the relationships discussed included an older or senior individual that advised or counseled the student, which is typical to mentor relationships. A couple of students

characterized their mentor as father type figures or even their 'MIT father.' Others who had academic advisors or non-UROP faculty as mentors said their mentors were like friends. They could be 'really real' with their mentor and discuss any difficulties they were having whether it was academic, based on research or even personal issues they were experiencing.

Alternatively, UROP mentors had a smaller sphere of influence for some students. Students felt that UROP mentors should not be bothered with personal problems or issues. One student reported a great relationship with her UROP mentor, in fact she intended to go on to a graduate program at MIT so she could continue her work with her mentor. When asked if her mentor had any impact on her personal life in terms of advice, or if she felt comfortable going to him if she had a personal issue, she said that she wouldn't want to "waste his time".

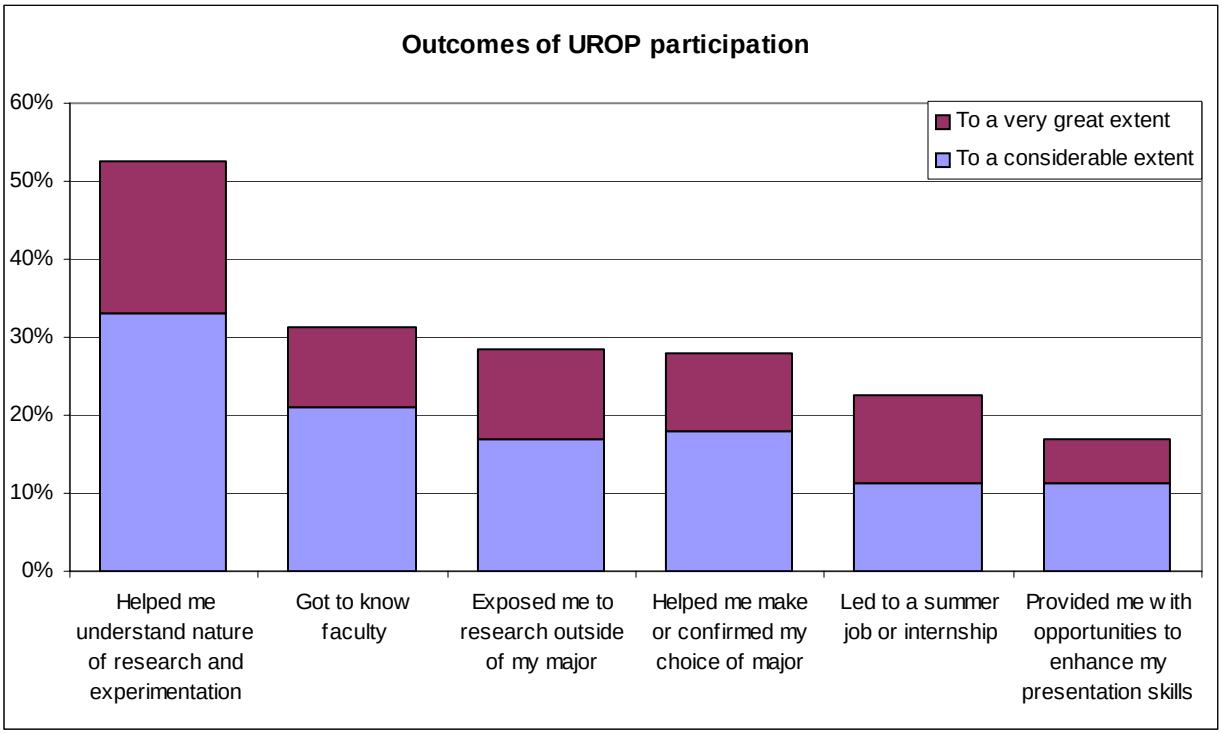
Quantitative Data Analysis Findings

Examination of the UROP variables included in the Enrolled Student Survey indicate that the majority of students felt the largest outcome from UROP participation came from the sense that UROP helped him/her understand the nature of research and experimentation (see Table 3). Less than one-third of students felt that getting to know the faculty was a major outcome from UROP participation (see Figure 2). These results suggest that developing mentor relationships through UROP may not be as pervasive as implied on the UROP website.

Table 3: UROP outcomes

Which of the following were outcomes of your UROP participation?	Not at all	To a slight extent	To a moderate extent	To a considerable extent	To a very great extent	N
Got to know faculty	14.9%	24.9%	28.8%	21.1%	10.3%	1162
Helped me understand nature of research and experimentation	10.1%	14.4%	23.1%	33.2%	19.3%	1158
Helped me make or confirmed my choice of major	34.1%	18.2%	19.7%	18.0%	10.0%	1151
Exposed me to research outside of my major	32.2%	17.8%	21.6%	16.9%	11.5%	1149
Provided me with opportunities to enhance my presentation skills	43.1%	21.6%	18.5%	11.2%	5.6%	1149
Led to a summer job or internship	53.7%	13.2%	10.5%	11.2%	11.4%	1136

Figure 2: UROP participation outcomes



Compare means. Once the indexes related to student-faculty relationships were created, mean responses for those that reported participating in UROP and those that did not, were compared. Those students that had participated in UROP had significantly more interaction with

faculty and were more likely to report that they relied on faculty for academic/professional advice (see Table 4).

Table 4: UROP participation T-Test

	Participated in UROP	N	Mean	t	df	p<
Faculty advice index	has not done UROP	1687	.0602	-12.077	4064.000	.000
	has done UROP	2379	.1137			
Faculty interaction index	has not done UROP	601	1.6888	-12.829	4061.231	.000
	has done UROP	1145	2.0007			

Regression and correlation analysis

To further determine the impact UROP participation has on developing mentoring relationships, several multiple regression models were analyzed. The dependent variable used in the multiple regression models was the faculty advice index which was used as a proxy to determine whether or not students found mentors at MIT. To begin, a correlation matrix that included the dependent as well as all of the independent variables was produced to determine the extent to which variables used in the regression models are correlated. (Table 5)

Table 5: Correlation Matrix for variables in the Regression models

	Faculty - academic and career advice	Student Year	GPA	Mother: Highest Degree	Father: Highest Degree	US Citizen	Asian American	African American	Hispanic	Caucasian	Female	urop	Faculty interaction
Faculty - academic and career advice	1.000												
Student Year	.082**	1.000											
GPA	.080**	.112**	1.000										
Mother: Highest Degree	.026	.003	.070*	1.000									
Father: Highest Degree	.050	.024	.081**	.616**	1.000								
US Citizen	-.042	.001	.146**	.098**	.037	1.000							
Asian American	-.010	-.009	.073**	-.038	.049	.014	1.000						
African American	-.042	.028	.154**	-.063*	-.148**	-.056*	-.110**	1.000					
Hispanic	-.074**	-.051*	.197**	-.143**	-.201**	.047	-.185**	-.054*	1.000				
Caucasian	.064*	.015	.076**	.105**	.066*	.045	-.679**	-.161**	-.151**	1.000			
Female	-.014	.050	.043	.091**	.094**	.099**	.121**	-.017	-.177**	-.066*	1.000		
urop	.204**	.257**	.239**	.006	.045	-.078**	.169**	-.036	-.167**	-.044	.029	1.000	
Faculty interaction	.564**	.077**	.081**	.046	.057*	-.023	-.020	.019	-.077**	.044	-.006	.199*	1.000

**Correlation is significant at the 0.01 level (1-tailed)
*Correlation is significant at the 0.05 level (1-tailed)

Results show that while many variables have a significant correlation, the value of the correlations all fall under .7, which means multicollinearity would unlikely be a factor.

The first multiple regression model was restricted to demographic variables. The logic behind this model is the fact that UROP is a program in which participation is completely voluntary. To rule out demographic variables that may impact UROP participation, this model was needed to help ensure that there are no known extraneous variables that may induce students to participate in UROP. In this initial model, student year was the only significant variable in terms of predicting whether students went to faculty for academic or professional advice. There is a positive relationship between time at MIT and finding a mentor.

In the second regression model, UROP participation was added. In this model, the significance of school year in predicting whether students go to faculty for advice was reduced. UROP participation was a better predictor, with a p value less than .05 and a Beta coefficient of .189 (Table 6). There was a .031 change in R-squared.

In the final regression model the faculty interaction index was added. R squared increased substantially to .332. Faculty interaction and UROP participation became the only two variables that were useful in predicting whether students went to faculty for advice.

Table 6: Regression Models for mentors

	Model 1			Model 2			Model 3		
	B	Std. Error	Beta	B	Std. Error	Beta	B	Std. Error	Beta
(Constant)	.126	.049		.134	.048		-.068	.041	
Student Year	.014**	.006	.075	.006	.006	.031	.003	.005	.019
GPA	.012	.008	.046	.003	.008	-003	-.001	.007	-.003
Mother: Highest Degree	-.001	.005	-.006	.000	.005	-.002	.000	.005	-.011
Father: Highest Degree	.005	.006	.034	.005	.006	.031	.002	.005	.012
US Citizen	-.019	.018	-.035	-.014	.017	-.025	-.014	.015	-.025
Asian American	.005	.016	.017	-.006	.016	-.018	.003	.013	.010
African American	-.018	.023	-.026	-.019	.023	-.028	-.030	.019	-.044
Hispanic	-.023	.018	-.047	-.016	.017	-.032	-.006	.015	-.011
Caucasian	.018	.015	.058	.015	.015	.048	.018	.013	.061
Female	-.008	.010	-.026	-.007	.009	-.023	-.004	.008	-.013
Participated in UROP				.066***	.012	.189	.030**	.010	.086
Faculty Interaction							.140***	.007	.543
R-Squared		.021			.052			.332	
N		1051			1051			1051	

*p<.10
**p<.05
***p<.001

Discussion and Conclusion

By using the literature review and qualitative portion of this study as a reference point to guide me on my quantitative data analysis, empirical evidence suggests that UROP participation does explain some of the variability in whether or not students find mentors at MIT. When only demographic variables are taken into consideration, participation in UROP explains 4% of the variation in predicting who finds a mentor at MIT. Faculty interaction, with an R-squared of .332 is a much better predictor in terms of who finds mentors at MIT.

While UROP may give students an opportunity to work closer to faculty members, due to the intimate nature of research collaborations when compared to a classroom setting, it does not necessarily foster a mentor relationship. Several factors including a supervisor's commitment to building a relationship with the student (forming a personal relationship with the student and creating a work environment that allows for feedback) and regular interaction with the student are instrumental when students consider whether supervisors should be classified as mentors.

Future research on UROP and mentors at MIT should involve the development of a more comprehensive survey instrument. Data gained from the qualitative interviews could aid in the

development of this new survey instrument which should include how often students met with their supervisor and how often they were involved in particular interactions with their supervisor (i.e. formal meetings, feedback on work, etc),

UROP's informal structure may include the right ingredients for fostering mentor relationships, but it also may be a characteristic that prevents UROP from maximizing the effectiveness of mentor relationships. Encouraging more faculty-student interaction would be one way to increase the likelihood of the formation of a mentor relationship both within UROP and outside of UROP.

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