

# **Academic climate and advisor support affect the quality of womens' experiences in graduate school**

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## **Abstract**

Recent trends in graduate student enrollment in the Department of Mechanical Engineering at a major American university (Tier I Research) have demonstrated stagnation in the percentage of women students while the national statistics have shown a continuous increase in graduate women in mechanical engineering (nsf.gov). Graduate students are particularly affected by the social and physical environment within an academic department due to their frequent interactions with peers, faculty, and staff. In order to elucidate potential reasons for the decline in the enrollment of women, students' perceptions of their graduate school experience in the Department of Mechanical Engineering were sought. We conducted an anonymous survey of all graduate students in the Department in May 2006. The survey response rate was 29% (N = 98), and participants were representative of the overall population demographics. The results of this survey showed that, in general, students felt well supported by their peers, faculty advisors, and department administrators, and they were satisfied with the classroom and research facilities provided by the Department. There were statistically significant differences in student responses based on gender ( $p < 0.05$  for Student's T-test), namely, women felt: 1) less content with their overall experience (75% women vs 87% men), 2) less confident in their professional abilities after entering graduate school (68% vs 88%), and 3) less supported by their faculty research advisors (52% vs 12%). Overall, the survey reflects a positive climate for graduate students in the Department (80% of students responded positively to questions regarding their overall experience); however, there is room for improvement in the quality of the graduate school experience for women students. We suggest the following targeted areas of improvement: 1) develop a formal structure for providing feedback to students on achievements outside the classroom, 2) develop workshops addressing issues facing women graduate students to provide the tools and support for women without increasing the demands on individual faculty advisors, 3) host a workshop for faculty members focusing on best practices in graduate student advising, with a particular emphasis on interactions with women students, and 4) initiate student-sponsored social events specifically designed to foster peer interactions between international and domestic students. In response to our survey results, departmental administrators have initiated a dialogue with faculty members concerning their mentoring practices, and several student organizations have implemented peer-mentoring programs, workshops, and social events

for graduate students. We are planning a follow-up study in May 2008 to determine whether these positive changes have significantly affected the quality of the graduate school experience, particularly for women students.

## **Introduction**

The loss of women at each level of academia has been well documented (Mason and Goulden 2003) and is a concern for many leading American universities. At one major American university (Tier 1 Research) there has been stagnation in the number of women enrolling in engineering doctoral programs (18%). Furthermore, there is anecdotal evidence suggesting a disproportionate number of women graduate students changed their academic goal to a terminal master's degree after having started in the doctoral program. The plateau of women's enrollment at this university is contrary to the National Science Foundation's (NSF) recent finding of a trend towards increasing female enrollment in engineering doctoral programs (National Science Foundation 2007). Research has established that students are particularly influenced by their interactions with faculty outside the classroom (Colbeck, Cabrera, and Terenzini 2001; Sax, Bryant, and Harper 2005) and peers (Colbeck, Campbell, and Bjorklund 2000; Felder et al. 1995). Although much of their education takes place outside of the classroom, at most institutions graduate students are only given regular opportunities to evaluate faculty members in their roles as course instructors. For this reason, little is known about graduate students' perceptions of their peers, faculty advisors, and department administrators, all of whom may directly impact the quality of their graduate school experience.

Comprehensive studies of undergraduate student populations have shown significant relationships between a range of educational and personal outcomes and time spent interacting with faculty (Chesler and Chesler 2002; Colbeck, Cabrera, and Terenzini 2001; Felder et al. 1995) and student peers (Brainard and Carlin 1997; Colbeck, Cabrera, and Terenzini 2001; Felder et al. 1995). Furthermore, these interactions have been shown to have differing effects on male and female students (Rose 2005; Sax, Bryant, and Harper 2005). A recent campus-wide survey of graduate students at the same major University investigated in this study showed that mental health concerns were prevalent amongst graduate students and that faculty-student interactions impacted students' personal and professional lives (Mental Health Task Force 2004). Students who felt positively towards their faculty advisors were less likely to suffer from depression and were more likely to seek professional treatment. This same study also indicated that gender affects the graduate school experience. Men reported significantly higher satisfaction with their faculty advisors than women, met more frequently with their advisors, and were less likely to suffer from mental health problems while in graduate school.

Motivated by the results of this campus-wide study and the lack of feedback from students regarding their overall graduate school experience, we conducted a survey within the Department of Mechanical Engineering at the aforementioned major University (Tier I Research, US-based). This project was initiated, conducted, and analyzed by graduate students in this department, and we believe that the independence of the study from the University administration provided a unique perspective on the graduate student experience. The goals of this study were to assess the quality of the graduate school experience at a more local level and to provide a metric for continued improvement of departmental climate. Given the results of the campus-wide Graduate

Student Mental Health Survey, we were particularly interested in whether students felt that they were receiving adequate support from their peers, department administrators, and faculty advisors. Concerns from students also prompted us to survey family-related policies, discrimination, and adequacy of building and research facilities. The specific aims of this study were to: 1) assess students' perceptions of the Department's climate based on the physical and social environment, 2) determine if these perceptions were affected by such factors as gender, nationality, major field, and level of advancement in the Department, and 3) assess whether students' overall opinions of their graduate school experience were affected by the quality of faculty-student interactions.

## **Methods**

Graduate student leaders distributed anonymous paper surveys to all of their peers in the department. The surveys were numbered to prevent repeated submissions. Students were asked personal information, namely, gender, whether they were an international student, major field, year in school, and exam status. Exam status was defined as whether they had passed each of major departmental exams, specifically, 1) the written Preliminary Exam taken after the first year in the program and covering at least three mechanical engineering subfields, and 2) the Qualifying Exam, which is a comprehensive oral examination generally taken in the student's third to fourth year in the program. The survey consisted of 22 positively phrased questions with responses rated on an ordinal scale of  $-2$  (strongly disagree) to  $+2$  (strongly agree). Students were also given the opportunity to comment on each question.

Each survey statement was evaluated for correlation with the demographic characteristics of gender, nationality, year in the program, exam status and major field. Furthermore, in order to assess students' overall perceptions of faculty support, question responses were averaged for each student to generate a Research Advisor Index (RAI) (questions 3-9) and a General Faculty Index (GFI) (questions 10-12). As a preliminary study, multiple linear regressions were performed for each index with the individual question responses as predictors. These analyses suggested that the indices were valid measures because they are directly proportional to each of the question responses being averaged. Multiple linear regressions were performed to assess whether RAI and GFI were dependent on the student profile variables, i.e., gender, international or domestic student, etc. Lastly, we assessed the effects of RAI and GFI on students' response to two general questions, namely, "I feel good about my [university in question] grad school experience" and "Being at [university in question] has increased my confidence in my abilities as an engineer." Ordinal logistic models were constructed with the question response as the outcome and RAI or GFI as the predictor, accounting for student profile variables.

Statistical analyses of the survey data were conducted using commercial software (JMP v.5.0, SAS Institute, Inc., Minneapolis, MN). Contingency analyses were performed to determine if the response to each question was independently related to gender, international or domestic student, year in school, or Preliminary and Qualifying Exam status. A significant dependence was taken to be  $p < 0.05$  for the Pearson Chi-square test.

## Results

Of the 335 surveys that were distributed, 98 were collected (29% response rate). Survey distributions based on gender, international or domestic student, major field, year in graduate school, and Preliminary and Qualifying Exam status were comparable to the Department's population (Table 1 and Figure 1). A majority of student participants responded positively to every survey question (Table 2). Students felt most strongly supported by their peers, followed by their research advisors. Administrative and faculty support from individuals other than research advisors were less strongly rated. Student opinion of the Department's family-related policies was positive on average, but there was a large range of responses that included both highly positive and negative perceptions. The same was true for perceptions of discrimination as well as the adequacy of research and classroom facilities and the comfort level of the building.

The response to individual survey questions was influenced by student profile variables, with gender and international or domestic student status having the most prevalent and significant effects (Table 3). Women were more likely to feel less positively about their graduate school experience and were less likely to feel more confident in their abilities as engineers after entering Berkeley. In general, women also felt less encouraged and supported by their faculty advisors in meeting their research goals, and they were less comfortable approaching their research advisors with concerns. International students were less likely to regularly interact with students from other research groups, while domestic students more frequently perceived discrimination in the Department and were less satisfied with faculty support as graduate student instructors.

Students' overall opinions of their graduate school experience were affected by the quality of faculty-student interactions. The response to "Being at [university in question] has increased my confidence in my abilities as an engineer" was directly proportional to and correlated with the Research Advisor Index ( $p = 0.008$ ,  $R^2 = 0.16$ ). Gender was also a factor ( $p = 0.04$ ), with women feeling less confident in their abilities independent of the RAI. RAI was not correlated with students' response to "I feel good about my [university in question] grad school experience". The General Faculty Index was not correlated with the response to either question. Lastly, a paired analysis showed that RAI and GFI were not correlated with each other ( $p > 0.05$ ).

## Discussion

The results of this study show that the overall departmental climate is positive. Most students feel good about their graduate school experience and agree that this experience has increased their professional confidence. Students feel well supported by their peers, faculty, and department administrators. On average, research, classroom, and building facilities are seen as adequate and comfortable. Lastly, there are no perceptions of discrimination of any kind, and students feel that the Department is family-friendly.

Despite the generally positive perception of the Department across genders, our results showed that women felt less confident in their engineering abilities after entering graduate school than their male colleagues. This is in agreement with several previous studies that have demonstrated decreasing confidence levels in female students as they progress through their undergraduate and graduate studies (Brainard and Carlin 1997; Etzkowitz et al. 1994; Felder et al. 1995). This is despite the fact that they are performing at equivalent or better than their male classmates (Brainard and Carlin 1997; Felder et al. 1995). A study evaluating the role of gender

on the relationship between self-confidence and achievement showed that women had significantly less confidence than their male peers when approaching tasks specified as *masculine* (Lenney 1981). Furthermore, a significant difference in reported confidence levels was found when the women predicted their abilities relative to their male peers but no significant difference was found when women rated themselves against female peers (Lenney 1981). These results indicate that suggestions of engineering being a “*masculine*” profession and the lack of female peers in classroom and laboratory settings may passively contribute to further erosion of confidence levels in female students. These results reinforce the need for specific positive feedback for women in their academic environments. In graduate school, once students have completed their coursework, there is often minimal concrete feedback from research advisors or other faculty leaving students to gauge their own progress.

The lack of academic confidence in this population of women graduate students was correlated to the quality and quantity of interactions with their research advisors. Furthermore, this study showed that women students reported receiving less support from their research advisors than their male peers. This finding is in direct contrast to a comprehensive study of undergraduate engineering students that showed female students receiving more support from faculty than their male counterparts (Sax, Bryant, and Harper 2005). This contradictory finding might be attributed to the perceived quality of the student-faculty interactions and not just the quantity of interactions. Studies focused on gender perceptions of faculty student interactions found female students looked for different forms of support from their advisors than male students (Rose 2005). It is possible that even when the women were receiving nearly equivalent support as their male colleagues it came in a form that they did not find useful. Differing needs and expectations of advisors and mentors are not limited only to gender but have also been shown to correlate with the age and race of the student (Rose 2005). These findings suggest that faculty and research advisors need to be aware of different students’ needs and not take a one-size-fits-all approach to advising and mentorship. The current department structure of one advisor per student may be exacerbating the problems of lack of support and guidance women students feel. There are many new mentoring models such as 1) Multiple Mentors, 2) Peer Mentors and 3) Collective Mentoring, which may better serve students, needs (Chesler and Chesler 2002). It is recommended that graduate students be encouraged from their first day to use many advisors and mentors throughout their education and not to depend on a single research advisor to meet their technical and career development needs.

Support from peers is also a factor in creating a positive academic climate for women (Colbeck, Cabrera, and Terenzini 2001; Colbeck, Campbell, and Bjorklund 2000; Felder et al. 1995; Seymour and Hewitt 1997). Reviews of undergraduate women engineering students showed women being devalued by male peers in group work situations (Seymour and Hewitt 1997). Our study found women graduate students felt equally supported by their peers as male students. This may be a reflection of women students learning to adapt to their underrepresented status and developing their own peer networks of support. Interestingly, this study found a significant difference between international and domestic students in their reported interactions with peers outside of their research group which may be indicative of cultural isolation. Department-wide social activities are suggested as a means to encourage more peer interactions and improve the academic climate for all students.

This study is a first attempt at assessing student perceptions of the working environment within the mechanical engineering department of the major university in this study, and there are both strengths and limitations to our approach. In support of our methods, the response rate was very high, especially for a voluntary survey, and the sample was representative of the student population demographics. We focused the survey questions on areas of interest based on the results of a previous campus-wide survey and comments from our sponsor groups' constituents. The principal limitation of this study was that it was not designed by a trained demographer, and there may be bias in the phrasing of the questions and the scoring of the response. Despite this limitation, we believe that the results suggest trends that may be investigated in future studies, possibly conducted by professionals in graduate-level administration. Finally, the population of interest was a single department within one academic institution, which may limit the general applicability of these findings. However, most of the findings substantiate previously reported trends for female science and engineering students. Furthermore, the findings reinforce that even in a highly ranked program, where all students required exceptional credentials simply to be admitted, women graduate students still faced the same issues of lack of self confidence and faculty support as their peers across the nation.

This study not only provides information about the current student population, but also constitutes a baseline from which to measure the effectiveness of initiatives to improve the academic climate. Based on the results of our study, department administrators assembled a task force of faculty, students, and administrators to develop and execute strategies for improving the graduate student experience, particularly for women and other underrepresented groups. We recommended four action-items, all of which have been fully or partially implemented over the past 12 months. These items were to: 1) develop a formal structure for providing feedback to students on achievements outside the classroom, 2) develop workshops addressing issues facing women graduate students to provide the tools and support for women without increasing the demands on individual faculty advisors, 3) host a workshop for faculty members focusing on best practices in graduate student advising, with a particular emphasis on interactions with women students, and 4) initiate student-sponsored social events specifically designed to foster peer interactions between international and domestic students. We are currently planning a follow-up study to evaluate the effectiveness of these programs.

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Student characteristic	Survey (N = 92)	Department (N = 335)
Gender		
Male	77%	81%
Female	23%	19%
Nationality		
International	47%	44%
Domestic	53%	56%
Exam status		
Have Not Passed Prelims	24%	Not available
Passed Prelims Only	34%	Not available
Passed Quals	42%	Not available

Table 1: Survey population demographics presented as percentages of the total number of respondents. Departmental demographics are also presented where available

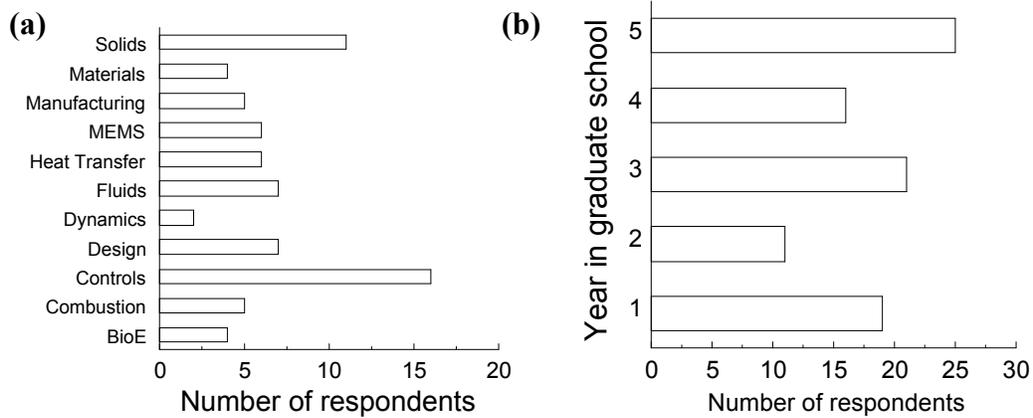


Figure 1: Survey population by (a) major field and (b) year in graduate school

Category/Question	Positive [%]	Neutral [%]	Negative [%]
<b>Overall experience</b>			
1. I feel good about my [university in question] grad school experience.	85	8	7
2. Being at [university in question] has increased my confidence in my abilities as an engineer.	74	11	15
<b>Research advisor</b>			
3. I feel satisfied with the support I am receiving from my research advisor.	76	10	14
4. It is easy for me to meet with my research advisor when I need to.	76	13	11
5. I receive constructive feedback from my research advisor.	72	15	13
6. My research advisor encourages and supports me in meeting my goals.	82	10	8
7. I feel comfortable approaching my research advisor with concerns.	77	12	11
8. I would encourage new grad students to work with my research advisor.	74	11	15
9. My research advisor respects the fact that I have academic obligations (classes, exams, etc.) in addition to my research.	86	7	7
<b>Other faculty and administrative support</b>			
10. I feel satisfied with the support I have received from professors of classes in which I have been a GSI (graduate student instructor).	67	18	15
11. I am satisfied with my interactions with faculty that are NOT my research advisor.	74	17	9

12. I am satisfied with the faculty support I received while preparing for Preliminary/Qualifying Exams.	57	30	13
13. I feel satisfied with the support I am receiving from the administration in obtaining my degree.	69	18	13
<b>Peer support and interactions</b>			
14. I feel supported by my fellow students.	81	16	3
15. There is a positive interaction between American and International students in classes and research labs.	77	16	7
16. I regularly interact with students from other labs.	65	14	21
17. As a graduate student instructor, I feel respected by the students in the class.	87	11	2
<b>Facilities</b>			
18. I have adequate facilities to conduct my research.	66	18	16
19. I can work comfortably in my building.	53	20	27
20. I feel that the classroom facilities are conducive to learning.	63	25	12
<b>Discrimination</b>			
21. The department is free from discrimination of any kind.	65	24	11
22. The department is family-friendly in their policies towards student parents.	55	17	28

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Table 2: Overall responses for the survey population. Questions are quoted verbatim and are categorized

Category/Question	Positive [%]	Neutral [%]	Negative [%]
<b>Gender (male/female)</b>			
1. I feel good about my [university in question] grad school experience	87 / 75	3 / 25	10 / 0
2. Being at [university in question] has increased my confidence in my abilities as an engineer.	82 / 52	12 / 10	6 / 38
6. My research advisor encourages and supports me in meeting my goals.	88 / 68	6 / 16	6 / 16
7. I feel comfortable approaching my research advisor with concerns.	78 / 68	11 / 16	11 / 16
<b>Nationality (International/Domestic)</b>			
10. I feel satisfied with the support I have received from professors of classes in which I have been a GSI (graduate student instructor).	77 / 59	19 / 19	4 / 22
16. I regularly interact with students from other labs.	54 / 74	28 / 4	18 / 22
21. The department is free from discrimination of any kind.	75 / 60	15 / 31	10 / 9
<b>Year in program (1/2/3/4/5 + )</b>			
18. I have adequate facilities to conduct my research.	77/70/67/ 36/72	0/30/14/ 43/12	23/0/19/ 21/16
<b>Passed Qualifying Exam? (Yes/No)</b>			
15. There is a positive interaction between American and International students in classes and research labs.	89 / 70	8 / 22	3 / 8

Table 3: Survey questions with student responses that depended on demographic characteristics ( $p < 0.05$ ). There were no statistically significant differences in responses based on major field or Preliminary Exam status.

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