Defining Academic "Quality": The Gendered Effects of Admissions Criteria in Doctoral CS and CE Programs[1]

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ABSTRACT

The male-dominated field of computer science and computer engineering (CSE) is the context for our examination of admission practices that affect women's representation. Data are analyzed from a survey of 48 graduate CSE departments in the United States, as well as from five sex-segregated focus groups. We develop a model based on our quantitative findings about variation in women's share of departmental enrollment. Using qualitative data to interpret the model, we find that ambiguous and non-academic criteria play an important role in the admissions process and in women's representation, despite widespread importance placed on formalized, merit-based criteria. The most influential factors differentiating departments appear to be the value faculty put on diversity and faculty beliefs about backgrounds of successful students. We discuss how these findings suggest that formalizing processes of evaluation in male-dominated fields will not suffice to improve women's representation.

LITERATURE REVIEW

Few fields better exemplify the lack of women in elite positions than computer science and computer engineering (CSE). Women's underrepresentation is especially evident in graduate programs, where new PhDs are trained to be leaders in the field. Even as gender diversity increases in other science, technology, engineering, and mathematics (STEM) disciplines, CSE remains male dominated with women's representation at the doctoral level persistently below 25% (calculated with data from Webcaspar). This male overrepresentation in CSE makes a significant contribution to the extreme sex segregation of many technical and scientific fields (Seymour and Hewitt 1996), and to the persistent sex segregation within educational systems and labor markets overall (Bradley 2000).

A supply-side gender imbalance at the undergraduate level accounts for only a portion of women's underrepresentation at the graduate level in CSE. Careers in CSE do not necessarily follow a "pipeline", so undergraduate outcomes cannot adequately explain the graduate gender imbalance (Jesse 2006). In a study of women's representation among doctoral recipients and faculty in the academic sciences, Kulis et al. (2002) find that the pattern of participation of women in computer science is unique, and they concur with other researchers that academic cultures and practices within departments contribute to creating and maintaining the gender balance in their enrollment (Cohoon, 2006; Fox 2001; Kulis et al, 2002).

Admissions practices are likely to play an important role in the gender composition of academic programs. In undergraduate admissions, criteria that indicate

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"merit" have been shown to be socially defined by dominant groups, promoting their admission over others (Karabel 2005). Similar effects have been observed in hiring and evaluation practices within traditionally male-dominated professions. Stereotypes and/or same-sex preferences create gender biases in selection and evaluation processes intended to be merit-based (Gorman, 2005; Reskin and McBrier 2000; Cohen, Broschak, and Haverman 1998). In the same manner, gendered stereotypes surrounding the practice of CSE could make women's entry into the field difficult (Wajcman 1991; Wright 1996). For example, when the unintentionally gendered practices of a leading undergraduate computer science program were changed, women's representation increased sharply (Margolis and Fisher 2001). This literature suggests that faculty-controlled admissions processes in graduate CSE programs could also involve implicit gendered practices that work to hinder or promote women's participation.

In this paper, we consider admissions criteria and faculty attitudes in graduate CS departments to determine their effects on women's participation. In particular, we consider whether recommended practices for overcoming gender bias at points of entry and evaluation are effective. In general, such practices consist of formalizing criteria for evaluation (Bielby 2000; Reskin 2003; Long and Fox 1995). It is argued that formalized criteria are important to limit decision makers' discretion, and thus to eliminate the use of sex and race in hiring and evaluation. These authors, basing their recommendations on syntheses of previous studies, conclude similarly that the availability and use of functionally-relevant, objective, and specific information on applicants prevents bias, while unstandardized, vague, and subjective criteria encourage the use of stereotypes and same-gender preferences. We explore the role of formal criteria and ambiguous criteria in graduate school admissions in a male-dominated discipline.

Finally, context, specifically in the form of institutional rank or classification, must be considered when attempting to explain women's representation in higher education. Researchers argue whether these institutional qualities are related to gender composition (for example, see Fox 1995; Jacobs 1999; Davies & Guppy, 1997). It appears, however, that when a single discipline is compared across institutions, women are less well-represented at institutions near the top of the educational hierarchy. For example, at the graduate level, women are most underrepresented at top institutions in mathematics and physics.[2] Therefore, institutional quality will be controlled in our analysis.

[2] At the undergraduate level, Jacobs (1999) attributes gender inequality to the presence or absence of engineering and education schools within an institution. Davies and Guppy (1997) find, however, that men are almost twice as likely as women to major in lucrative fields at selective institutions. Looking within disciplines across institutions, they uncovered the gender disparity. Barker and Garvin-Doxas (2003) confirm that this finding applies to computer science bachelors programs by showing that women's representation is lowest at large research extensive institutions. The difference in results obtained by looking at all STEM disciplines compared to looking within disciplines also explains why Fox (1995) concludes that men and women in science earn their doctorates from institutions of similar quality. She notes that there are substantial gender differences in institutional quality for mathematics and physics doctorates, but focuses on the broader equality when all scientific disciplines are considered. This focus overlooks the within-discipline disparity. The bottom line seems to coincide with Charles and Bradley's (2002) observation that within-discipline gender inequality is greatest among institutions at the top of the higher education hierarchy.

RESEARCH QUESTIONS

Based on the findings in the literature reviewed above, we propose the following hypothesis about how admission criteria affect the gender balance of computer science and computer engineering doctoral programs. Looking across institutions, but within the male-dominated discipline of CSE, we propose that:

- Women PhD students are less represented in CSE programs located in research extensive institutions[3] than in research intensive institutions
- Net of institutional classification, departments' use of functionally-relevant, objective criteria positively affect women's representation among PhD students
- Net of institutional classification, departments' use of ambiguous indicators of applicant quality is negatively associated with women's representation among PhD students.

DATA AND METHODS

This study is part of a larger project that considers the impact of departmental conditions and practices on women's recruitment, admission, and retention in graduate CSE programs in the United States.

Data

We recruited departments for the survey from a stratified random sample of all the U.S. postsecondary institutions with active doctoral programs in computer science or computer engineering. The sampling frame consisted of 147 CSE departments that awarded at least three doctorates in academic years ending 1998, 1999, or 2000. The frame was divided into three tiers according to the departments' NRC (1993) rating of faculty quality, plus an unrated group. Two samples (one for this study and one for another CRA study) were randomly selected from each group. Of the 60 departments (20 top-tier, 20 second-tier, 10 third-tier, and 10 unranked) selected to participate in this study, 49 departments accepted our invitation. The doctoral program in one institution was inactive, so this program was dropped from the study.

After extensive pretesting, we collected survey data in the fall and winter of 2003 using three different instruments: one for chairpersons, one for faculty, and one for graduate students. All full-time graduate faculty, and in most cases, all students in a department were invited to participate. In especially large departments, we randomly sampled up to 85 students, oversampling women up to 50%. The surveys were implemented through the web. We sent out multiple email reminders, and non-respondents received a paper questionnaire as a final follow-up. The subsequent response rates were 94% for chairpersons (46 chairs), 63% for faculty (789 faculty), and 55% for students (2012 students). Response rates for particular questions varied. The analysis results reported here are based on responses from 722 faculty members in 46 departments (two outlier departments were dropped from the analysis, as explained below).

[3] Carnegie Classifications prior to their recent update categorized research universities as either research intensive or research extensive, according to the number of degrees awarded each year. Thus, this differentiation rested primarily on program size, with extensive being larger than intensive. The current Carnegie Classifications now require very high research activity according to research and development expenditures as well as number of doctoral degrees awarded for inclusion in the "very high" group. We use the current classification assigned to our study institutions.

Methods

Two outliers were removed from the analysis, leaving us with 46 departments. Both departments had small numbers of students and extreme values for women's proportion of PhD students (one very high and one very low). Results of the analysis with and without outliers were similar, and will be compared briefly below.

Our independent variables are measured by faculty responses to admissions-related questions on the faculty survey. Since this paper focuses on the PhD program, those faculty members who indicated that they are involved with the master's program only were not included in the analysis (2% of faculty). Faculty members who had served as a member of their department's admission committee in the previous four years were asked to rate the importance they personally placed on each of a series of criteria for evaluating applicants. In addition, all faculty members were asked to indicate their level of agreement with certain admissions-related practices. These variables measure more general attitudes about diversity and student background, rather than the use of particular criteria for evaluation; we examine whether these attitudes explain the effects of admissions criteria on women's representation.

Appendix A provides a list of questions used, and shows our categorization of variables into the formal index, the ambiguous index, and other variables. The formal index consists of criteria that relate to academic background (functionally-relevant), in addition to being standardized or more easily quantifiable (objective); we limited the index to those academic criteria for which there was a high consensus of importance among faculty (see table 1 below). For the ambiguous index, we summed the vague and unstandardized variables that respondents considered most important. Other variables that did not clearly fit in an index or were generally rated less important by responding faculty were considered individually for their affect on women's representation.

Our dependent variable, female proportion of PhD students, was computed based on responses to the chairperson survey requesting numbers of total students and females enrolled. Missing data was obtained by contacting departments via phone. The resulting variable, female proportion of PhD students, is imperfect as it ignores students lost through attrition, but more accurate data were not available.

Our analyses took into account institutional and other environmental conditions that might affect women's representation. Only one of these, however, proved to be relevant. After testing faculty quality according to 1993 NRC rankings, program size, public or private institutional control, student/faculty ratio, and women's representation on the faculty, only Carnegie classification as research extensive or research intensive had a significant effect on women's proportion of Ph.D. students. The model we present in this paper controls only for Carnegie classification.

FINDINGS

We find that CSE doctoral programs vary in their gender composition. Women's representation is greater in research intensive institutions, and in CSE departments where admissions decisions emphasize diversity and life experience, but not computing volunteer or work experience. There was no measurable effect from the objective academic admissions criteria employed by CSE departments.

Gender composition varies across doctoral CSE programs.
Figure 1 illustrates the distribution of women's representation in our study programs. The minimum was seven percent women; the maximum was thirty-six percent women. The average enrollment was 20 percent women, which is similar to both CRA Taulbee Survey (Zweben & Aspray, 2004) and Integrated Postsecondary Education Data System data (Webcaspar), although our data may present a slightly rosier picture of women's representation. The range in women's representation according to our data may also present a slight upgrade from the national reality. Differences in the mean and variance suggest that our study may underestimate effects on women's representation.

Women's representation is lower in CSE doctoral programs at research extensive institutions.
Carnegie classification has a significant negative association with women's representation (r= -.35, sig. at the .01 level). In our research extensive study departments women average 18 percent of enrollment, compared with 23 percent in the other departments.

Criteria for admission routinely include non-academic difficult to measure indicators of applicant quality.
Faculty respondents rated the importance of 25 possible admissions criteria. (See Appendix A for the complete list of possible criteria.) The two criteria rated most important were both somewhat ambiguous because they were less specific and standardized and their measurement leaves room for discretion. Top rated was the general quality of an applicant's academic record, as illustrated in the "Mean rating" column of Table 1.[4] Almost all the faculty members in the average department consider this a very or extremely important criterion for admission. Second rated is applicant motivation, followed by grades in computing courses and academic letters of recommendation. Every item on this list is considered by at least half the faculty in the average CSE admissions committee to be a very or extremely important criterion.

Our qualitative evidence supports the conclusion that admissions processes are holistic, involving both formal academic measures and more subjective criteria. Interviewed faculty frequently referred to students as "qualified" or not, alluding to quality as if it were straightforwardly or objectively determined. When describing the actual deliberation process, however, there was much more ambiguity. Faculty often mentioned that there is no formula for identifying prospective students who will succeed in their program, and that test scores do not necessarily predict success. In addition, choices must frequently be made between students with comparable academic backgrounds, making non-academic factors important. One faculty member from a highly-ranked program said that although their applicants are very competitive, have excellent grades and high test scores, "…our tendency is to look at it as holistically as possible, because the number crunching part of it is useless…" He said letters of recommendation, prior research, and what the student says about him or herself are also very influential. Referring to the latter, he said, "I think [the committee responds] to what

[4] For most of this discussion, percentiles of responses in the "not at all important," "slightly important," and "moderately important" categories will be summed and compared with summed percentiles of responses in the "very important" and "extremely important" categories. Percentiles are rounded to the nearest whole number.

students say about themselves and about things outside of computer science. I've heard many remarks when someone admires what the student has done, or overcome, or has accomplished…interesting hobbies if they choose to talk about it …And often, the comments are going to be more about those things than necessarily the actual technical aspects of the experience of the student." Whether from a top-ranked or other program, faculty agreed that determining an applicant's "quality" was not straightforward, even though all programs used several objective measures to determine quality.

Research extensive departments emphasize slightly different indicators of applicant quality than other departments. Table 1 shows the differences between institutions Carnegie classifies as research extensive and research intensive ("other institutions" in our table). For example, compared with other institutions CSE admissions committees in research extensive institutions put more importance on letters of recommendation, research experience, and area of research interest than do other admissions committees, and they put less emphasis on grades and GRE scores (not significant). Thus more competitive programs tend to emphasize more ambiguous criteria over the standardized academic criteria.

Faculty attitudes show interest in increasing diversity and little belief in fundamental gender differences.

We also compared average faculty beliefs about admissions practices by department across institution type (Table 2). There were no significant differences between research extensive departments and other departments. Overall the responses indicate why faculty emphasize both formal and ambiguous criteria – they seek students with both the technical ability and the life experiences that will make them successful in the program. Most faculty want to increase diversity, and few believe that this would entail lowering academic standards. In addition, relatively few faculty believe that CS/CE is inherently unattractive to women.

Faculty consideration of life experiences in admissions decisions advantage women's representation in CSE doctoral programs through ambiguous admission criteria.

Controlling for Carnegie classification, we tested to see if the use of academic "objective" criteria increased women's participation. We computed a measure of formal criteria in the admissions process by summing departments' mean importance rating for grades in computing courses, research experience, math background, GRE Score, and reputation of undergraduate institution or program. Regressing women's representation on the formal index showed no significant linear relationship. In addition, none of the individual indicators in the index was related to women's representation at the .05 level of significance. We also found that research extensive institutions did not differ from research intensive institutions on the index.

We then tested to see if ambiguity in important admission criteria disadvantaged women, again controlling for Carnegie classification. We computed a measure of ambiguity in the admissions process by summing departments' mean importance rating for general quality of academic record, motivation, communication skills, maturity, and academic letters of recommendation. Regressing women's representation on our ambiguity index showed a statistically significant positive linear relationship (ambiguity b=.016, sig. at .05). In other words, contrary to our expectation, ambiguity in admissions criteria seems to work in favor of women's admission to CSE doctoral programs. This

relationship is explained by faculty attitudes about considering life experiences in the admission process. Faculty beliefs that "life experiences should be considered when evaluating students for admission into the graduate program" had a stronger relationship with representation (.50, sig. at .00), and when entered into the model caused ambiguity to become insignificant. None of the other admissions-related attitudes was related to women's representation when entered into the model with Carnegie and life experiences (using .05 significance level).

Interviews with faculty provide examples of important life experiences and how they relate to a student's potential for success. One faculty member explained, "the things that I have learned to look for are both life experiences that indicate that they can act independently and overcome difficulties…and also experiences that indicate that they're really interested in finding out the reasons for things… That tells me that they are more likely than an average person to be a good researcher." Another faculty member made a connection between placing importance on life experiences and women's representation. According to this faculty member, considering "the totality of the undergrad career to student organizations, work experiences, summer programs and travel and all sorts of things," would allow for more diversity. The faculty member added, "And that doesn't end up changing the productivity of graduate students in terms of papers produced or other kinds of measures, but it does end up providing a more balanced admissions process for women." Our analyses support this conclusion.

Other non-academic criteria also affect women's participation.

In addition to the indexes discussed above we tested the effect of other criteria on women's representation. There was less faculty consensus on the importance of these criteria, which included some quantifiable criteria, some ambiguous criteria, and some in between. Two criteria, computing volunteer and/or work experience, and membership in an underrepresented group were significant in the model.

Gender diversity increases when membership in an underrepresented group is valued as an admission criterion.

There is more gender balance in CSE graduate programs where members of the graduate admissions committees place importance on membership in an underrepresented group. On average this criterion is considered between slightly and moderately important (2.6 on a 5-point scale of importance). Faculty attitudes about admissions and diversity do not explain this relationship, perhaps because the latter is a department average, whereas membership in an underrepresented group was a criterion actually used by admission committee members.

The mean responses presented in Table 2 show that faculty in the average department generally support diversity. Then one might ask why few admission committee members place importance on this criterion. The contrast between faculty endorsement of gender diversity and use of it as an admission criterion was explained by an overriding concern for quality. Faculty members may see gender as unrelated to applicant "quality", as negatively related to applicants' potential for success, or as a source of quality for the department and discipline. The last view makes it possible to recruit diverse students while still using "quality-based" admissions criteria.

Faculty members who see students' membership in an underrepresented group as an indication of quality define "quality" as including what the applicant would

contribute to the department's intellectual environment. For example, one faculty member explained that bringing in a diverse student body contributes to "the best academic environment, in terms of different opinions, in terms of engineering, or different viewpoints…It's essential to increase our academic abilities." Another faculty member commented on the importance of having "a diverse group, both in terms of the subject areas they come in at, as well as their personalities and culture and background." Yet another said, "[Students] have to learn to work with different people in different circumstances." Thus, according to these faculty members, diversity is a relevant factor in evaluating applicants' quality because diversity provides intellectual and practical experiences conducive to the success of all students in the department.

Faculty members who endorse diversity as an admission criterion generally see it as a way to distinguish among applicants who are equivalent with respect to other measures of quality, such as grades. For them, considering diversity does not minimize the importance of other measures of "objective" quality. In contrast, faculty who see diversity as unrelated to quality believe that considering it in the admissions process gives an advantage to students who are less well qualified. For example, one faculty member said, "I think the term "affirmative action" means that, and the folks who promote affirmative action will agree, that yes, when you do affirmative action, you accept a lower caliber candidate, rather than a higher caliber candidate, in the name of diversity. Pure and simple, that dilutes the quality of the talent pool." This faculty member did not see how considering diversity in the admissions process could be other than a trade-off with "quality." Thus, there were divergent views about whether an applicant's membership in an underrepresented group could be considered a measure of "quality." All faculty members' viewpoints were similar, however, in that no one felt that "objective" measures of quality should be compromised.

Computing work or volunteer experience negatively affects CSE doctoral program gender balance.

With Carnegie classification, life experiences, and underrepresented group in the model, we tested other admissions criteria for affect on women's portion of PhD students. Women's representation is lower in CSE doctoral programs that emphasize computing work or volunteer experience as an admission criterion. Whether in research extensive institutions or not, faculty rated this applicant characteristic as a little less than moderately important (2.7 on a 5-point scale of importance), but the faculty at more gender-balanced programs put less emphasis on it. Once again, faculty attitudes about admissions-related practices did not explain this relationship.

Women's representation is predicted by importance placed on diversity as a criterion, and by the emphasis put on non-academic computing and life experience criteria.

Based on our findings, we created a model of admission criteria and attitudes that affect gender diversity in doctoral CSE programs. Our model explains 46 percent of the variance in women's representation across CSE doctoral programs. Standardized effect sizes are shown in Table 3.

DISCUSSION

Our data support only the predicted effect of our control variable, but suggest important refinements in our thinking about the effects of ambiguity in admissions. We found that women's representation in CSE doctoral programs is indeed lower in research extensive institutions than in research intensive institutions. Furthermore, when controlling for Carnegie classification, we found no significant positive effects from the use of functionally-relevant, objective admissions criteria, nor did we find the expected negative effects from use of ambiguous criteria. Instead, it appears that women's representation is related to particular non-academic criteria. It is especially low when computing work or volunteer experience is emphasized and higher when life experience is emphasized. Not surprisingly, the deliberate application of diversity as an admission criterion also has a positive effect on women's representation.

Criteria such as "motivation," "maturity," and "communication skills" are deeply embedded in the admissions process for doctoral programs. The multi-faceted skills required to complete a PhD encourage the use of ambiguous and non-academic criteria such as these; faculty described the search for qualities such as initiative, creativity, leadership, people skills, none of which are easily measurable through standardized means. Ambiguous criteria may be especially important when intense competition brings high numbers of skilled individuals to the consideration of admissions committees. Large pools of academically successful applicants lead admissions committees to rely on the more difficult to measure criteria for distinguishing among applicants. Comparison of institutions by research intensity supports this explanation because the more competitive and elite the environment, the more likely faculty were to emphasize ambiguous criteria.

Ambiguous criteria are not necessarily unfavorable to women. Their effect depends on the indicators selected and the values of admission committee members. According to our data, women are almost absent from programs that emphasize work or volunteer computing experience. It is not likely that exclusion is the intent, since departments that apply this criterion are also likely to apply diversity as an admission criterion. Nevertheless, the net effect is to depress women's representation. On the other hand, life experience is an even more ambiguous criterion, but it positively affects women's representation. These outcomes result from real differences in the backgrounds of male and female applicants. Men have more extensive technological extracurricular experience, and women have more varied outside experiences (Margolis and Fisher 2001; Wright 1996). When departments rely on criteria related to these differences for ascertaining whether applicants are motivated or "the kind of person" they desire, they significantly affect their gender balance. There are gendered consequences from the ways faculty define and assess applicant quality when it comes to ambiguous and/or non-academic criteria.

Where faculty value gender diversity and apply that value to their admission decisions, women's representation is greater than in departments where diversity is not considered. Bowen and Bok (1999) argue in favor of considering diversity with respect to racial diversity and undergraduate admissions. They encourage admissions officers to consider applicants both individually and as a group based on their potential for academic success as well as their contribution to the educational process and to society. Their argument also applies to doctoral programs where leadership, initiative, and creativity are important. Most CSE admission committee members, however, did not employ gender

diversity as a criterion, and some considered it irrelevant. Our analysis indicates that under these conditions, women's representation remains low.

Our data demonstrate the need for further research into the gendered effects of institutional type. They also point to the need for greater recognition of the critical role played by ambiguous criteria, and that they are likely to continue to be part of admissions decisions. This reality calls for departmental discussion of how ambiguous and non-formal criteria are assessed and their consequences for particular groups of people. It appears that formalizing admission criteria is not enough to create gender parity in male dominated disciplines, especially at elite institutions. In situations where there are many "functionally relevant" skills that are difficult to measure, whether or not subjectivity and bias come into play, the indicators selected are likely to have gendered consequences. Under these conditions, commitment to diversity may be the most important way of increasing women's representation.

CONCLUSION

In a setting where women's representation is especially low, ambiguous criteria and non-academic criteria have substantial impact on the gender balance in academic programs. These findings indicate that admission practices affect levels of sex segregation in academic departments. Ambiguous criteria and other criteria that relate to "the kind of person you are" appear to be especially important for distinguishing among competitive applicants with comparable formal backgrounds. In academic settings where diversity is generally valued, non-formal admissions criteria can both advantage and disadvantage women. In settings with less commitment to diversity, there may be more potential for ambiguous criteria to disadvantage women, suggesting that formalization alone will not be sufficient for reducing gender segregation.

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APPENDIX A

Variables measuring importance placed on admissions criteria

Faculty were asked, "How much importance did you personally place on each of the following criteria when you evaluated applicants?"
Response categories were 1= not at all important, 2= slightly important, 3= moderately important, 4= very important, and 5= extremely important.

Formal Criteria Index:
Grades in computing courses
Research experience
Math background
GRE Score
Reputation of undergraduate institution or program

Ambiguous Criteria Index:
General quality of academic record
Academic letters of recommendation
Motivation
Communications skills
Maturity

Other criteria tested:
Undergraduate degree in a computing major
GRE CS subject Exam score
Area of research interest
Computing experience
Work or volunteer experience in the computing field
Work or volunteer experience in non-computing fields
Having been away from formal education for a time
Membership in an underrepresented group
Undergraduate degree from this institution
prior graduate degree
Desire to use technical skills for social good
Leadership experience
EE background
Grades in non-computing courses
U.S. citizenship

Variables measuring admissions-related attitudes

Faculty were asked, "Please indicate the extent to which *you* personally agree or disagree with the following statements."
Response categories were -2= strongly disagree, -1= somewhat disagree, 0= neutral, 1= somewhat agree, and 2= strongly agree, and were converted to a scale of 1 to 5 for analysis.

Questions:

Students without a computer science undergraduate degree can be successful in getting a Ph.D. in computer science.

The students who are most likely to succeed in graduate school are those with innate technical ability.

Life experiences should be considered when evaluating students for admission into the graduate program.

The department should actively recruit students from underrepresented groups (i.e., women, minorities, students with disabilities).

Activities meant to diversify the graduate student body will lower the academic quality of incoming students.

CS/CE as a discipline is inherently unattractive to women.

Figure 1

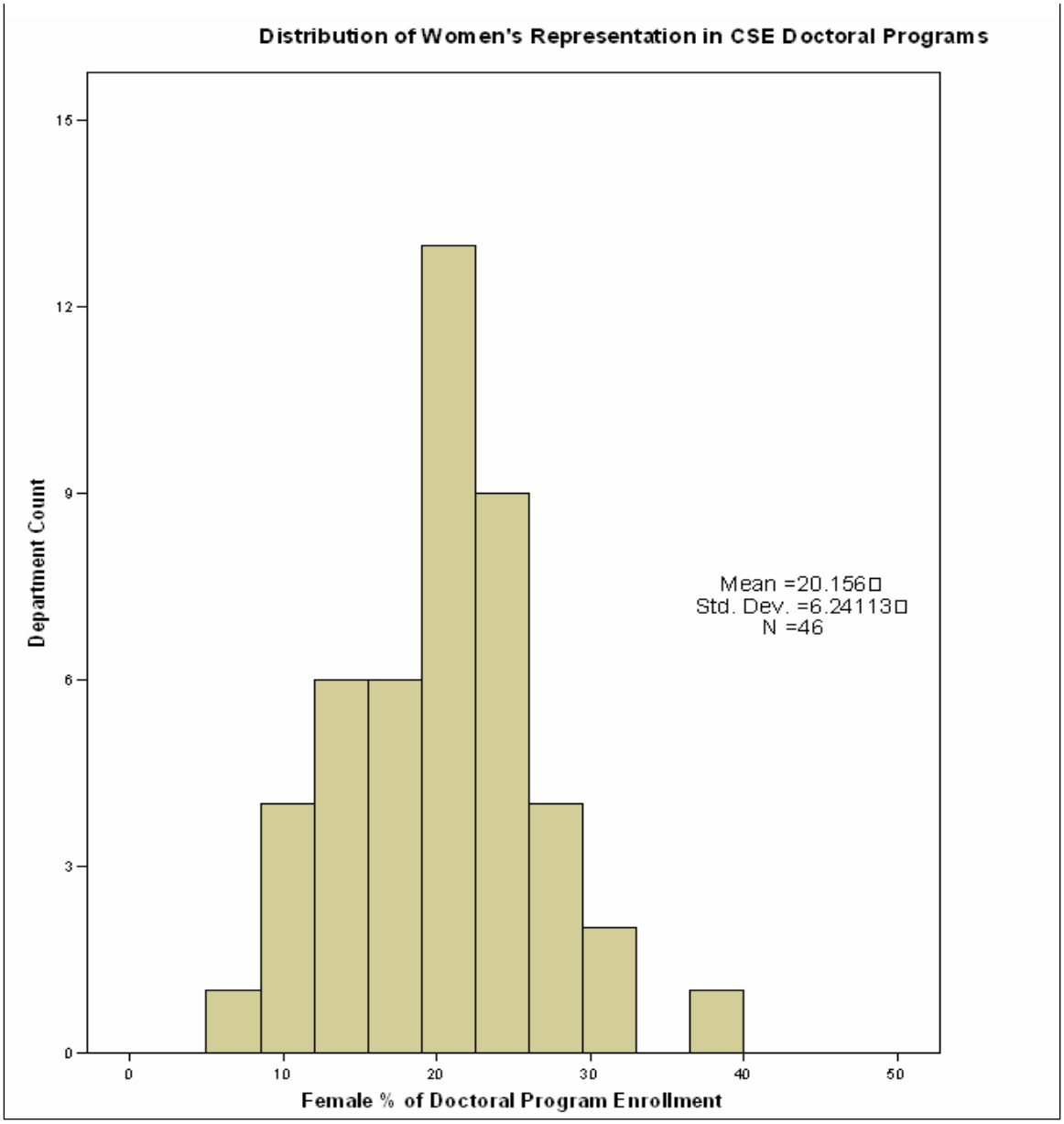
Distribution of Women's Representation in CSE Doctoral Programs
Department Count
15
12
9
6
3
0
Mean =20.156
Std. Dev. =6.24113
N =46
0
10
20
30
40
50
Female % of Doctoral Program Enrollment

Table 1. Top 12 Criteria for Graduate Admission

	% very or extremely important				Mean rating†
	Res. Exten.	*Std. Dev.*	*Res. Inten.*	*Std. Dev*	
General quality of academic record	94	10	98	9	4.4
Motivation	89	11	86	13	4.3
Grades in computing courses ∞	85	13	94	10	4.2
Academic letters of recommendation **	86	20	71	33	4.2
Reputation of undergrad institution or program	74	17	70	14	4.0
Communication skills	73	17	64	22	3.8
Math background	70	14	63	27	3.8
Research experience **	70	22	51	27	3.8
GRE score	52	19	67	27	3.8
Computing experience	58	17	52	25	3.5
Area of research interest ∞	58	24	42	27	3.5
Maturity	52	14	45	26	3.4

* Difference between research extensive and other departments' mean ratings is significant at .05 level

** Difference between research extensive and other departments' mean rating is significant at .01 level.

∞ Difference between research extensive and other departments' mean ratings is significant at .10 level.

†Mean rating on a 5-point scale where 1=not at all important and 5= extremely important.

Table 2. Admissions-Related Faculty Attitudes

	% somewhat or strongly agree				Mean rating†
	Res. Exten.	*Std. Dev.*	*Res. Inten.*	*Std. Dev*	
Students w/o CS degree can be successful at PhD	82	8	85	11	4.2
Students with innate technical ability are those likely to succeed	62	11	16	61	3.6
Life experiences should be considered when evaluating students	55	13	53	16	3.4
Department should actively recruit underrepresented groups	82	11	77	21	4.1
Activities mean to diversify lower academic quality of incoming students	16	13	11	12	2.3
CS/CE as a discipline is inherently unattractive to women	20	9	24	22	2.4

†Mean rating on a 5-point scale where 1=strongly disagree and 5= strongly agree.

Table 3. Regression Results for Women's Representation

	Beta	t test Sig.
Carnegie Classification	-0.33	0.00
Member of underrepresented group	0.41	0.00
Computing work or volunteer experience	-0.36	0.01
Consider life experience	0.44	0.00
Constant		ns
Adjusted R-squared for model	0.46	0.00