Women Students in Computer Science:
Student Perspectives of Faculty Bias as a Possible Influence on Student Retention

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Abstract:

Like many other computer science programs, UNCW loses more female students than male students to other programs. The purpose of this study was to determine if there was any difference between the perceptions of students who remained in the program and those who left toward faculty in the department and if these perceptions suggested a gender-bias among the faculty.

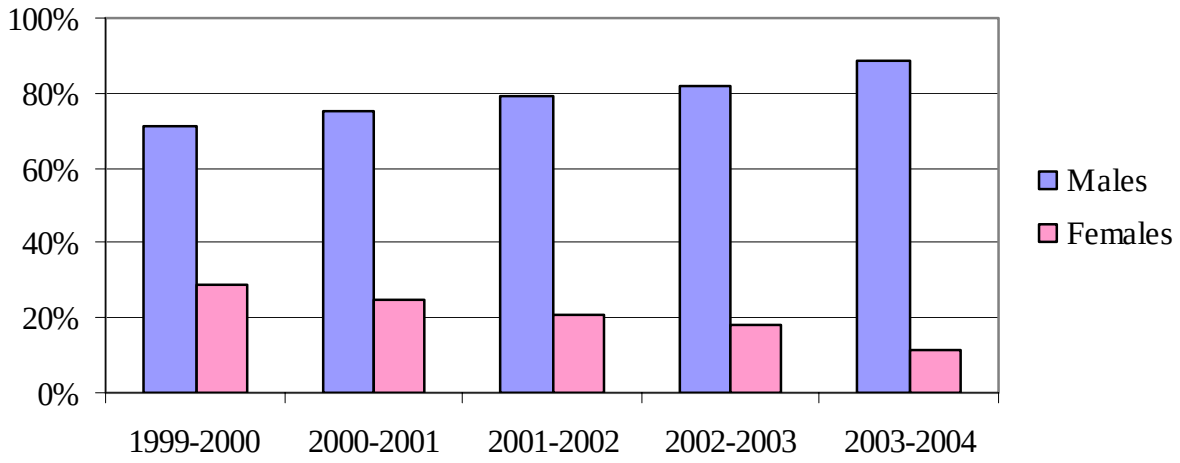
Introduction:

Like many other computer science programs, the Department of Computer Science at the University of North Carolina at Wilmington loses more female students than male students to other programs. Undergraduate degrees given in computer science at UNCW from July 1, 2000 to June 30, 2001 show that only 26.78% of the graduating population was female. Assuming that this graduating class started its computer science education four years earlier, the number of females entering the program at that time would have been 36 (or 35% of the student body). This statistic shows a possible loss of 21 female students (more than half) from entry to graduation while the number of males within the program remained fixed.

Enrollments at UNCW reflect the demographics of the region. Approximately 60% of the student body from spring semester 2004 is female. This number is based on head-count and includes both full-time and part-time students. The graduating classes of UNCW over the past five years have also reflected the same demographics. The average percentage of undergraduates degrees conferred during that time on women is 60.6%.

The computer science department, however, has a significantly different demographic for its students. Of the 148 students who are enrolled spring semester 2004 as computer science majors, only slightly more than 12% are females. This demographic is similar to the percentage seen from the computer science graduating class. Looking at the computer science graduation statistics over the past five years, 21% of the graduates have been women. Additionally, the percentage of female graduates has been steadily decreasing over the past five years. Figure 1 shows the graduation rates for both male and female students. Not only are female students leaving the program at a higher rate but they are entering the program at lower rates.

Figure 1: Graduation rates in computer science at UNCW.



Literature Review:

To determine if there were specific reasons for the low representation of females graduating with computer science degrees, a literature search was done. The review yielded several studies that suggest that there are reasons why women leave computer science programs at a higher rate than do men. Factors that may contribute to the departure of women from computer science include parental encouragement, peer pressure (Clarke & Teague, 1996, p. 241), student-teacher interactions, curriculum (in particular, high school mathematics and science courses), self-perception, mentors and role models, career aspirations, and resources in the home that are available to the students (Bae and Smith, 1997, p. 2). In a study conducted with women working in the field of technology education, Flowers (1995, p. 31) finds that there are still obstacles that make it difficult for women to remain in the field. These obstacles include stereotypes; lack of support; attitudes of counselors, students, and teachers; and a gender-biased curriculum. In addition, there are studies that suggest there are different learning styles for men and women that may influence the retention rate of women in computer science (Schwartz, 1988, p. 39).

While women entering other fields that are primarily occupied by men face similar obstacles, there are some unique issues specific to entering computer science (Sackrowitz and Parelius, 1995, p. 1). The computer science field uses languages that are specific to the field (such as C++, JavaScript, and FORTRAN). These languages follow different rules and syntax from a human's natural language, and there may be different rules among the various languages (Sackrowitz and Parelius, p. 1). In addition, computer science can be viewed as a very isolated field where computer scientists work individually without a great deal of interaction with other individuals (Sackrowitz and Parelius, p. 1).

Whatever the explanation, it has also been suggested that, rather than one particular reason for the lack of retention, there may be a combination of reasons that may be subtle and long-term (Sanders, 1993, p. 32). There is also the belief that females may just choose not to enroll in computer science for no apparent reason (i.e. nothing specific has been done to discourage them from enrolling; Johnson and Miller, 2002, p. 9).

Survey Development:

To determine if any of the reasons found in the literature were factors in the low number of females retained in the program, it was decided to survey students associated with UNCW's computer science program. This meant that three groups were to be surveyed: 1) students who had successfully completed the program (denoted as "alumni" throughout this report), 2) students who had left the major for any reason (denoted as "formers"), and 3) students who could either successfully complete the program or who could leave (denoted as "currents"). This third group were students who were actively enrolled in the computer science program during spring 2003; the other groups primarily were students who had been enrolled in the program between fall 1998 and spring 2003.

Survey questions were based on students' experiences within the department as well as some high school experiences, feelings related to technology and computers, and people who may have influenced their decision to major in computer science. As the survey was developed, the questions focused on different outcomes. In addition to demographic questions (such as age and gender), other background questions were asked to provide insight into responses. These questions included why computer science was selected as a major, what courses were taken in high school, student access to a computer, comparisons between skill levels and abilities, preferred instructional formats, attitudes towards computers and technology, and people who had influenced their choice of major. Two questions specifically addressed what the department could do to attract and retain female students. The last set of questions specifically asked about practices of the department. These questions included how often students saw their computer science instructors outside of class, whether instructors were approachable, whether images or graphic used during class time presented females and males equally, whether instructors used gender-neutral terms, and whether students were comfortable asking questions or challenging the instructors during class.

The survey was developed to be an on-line survey comprised of two parts. The first part was housed on the UNCW computer server, using their common gateway interface (CGI) server to handle the responses. Upon submission of the anonymous survey, participants would be directed to the second part of the survey. The second part of the survey was housed on the Nova Southeastern computer server and used that CGI server to handle the responses. This second part was for an optional submission of student identification numbers. Participants were informed that if they wished to be included in the drawing for a gift certificate they could submit their ID number. Using two different servers, CGI programs, and e-mail addresses aided in keeping the responses anonymous.

Threshold Development:

As information from the literature search was collected, discussion focused on the point at which there was a gap between acceptable actions of the computer science department faculty and unacceptable actions. It was difficult to select an acceptable threshold; hence, an unacceptable threshold was first selected. Unacceptable was that there would be a difference between male and female responses or that there would be a difference between alumni, former, or current responses. The level of acceptability for gender-neutrality, then, became that there should be no difference between males and females or current students and alumni and former students in regard to the use of terms and images. For student actions, the level of acceptability was that there would, again, be no difference between male and female students regardless of status. Some of the questions focused on areas that were beyond the scope of the department and,

thus, no level of acceptability or threshold could be created for those questions. Questions with no thresholds were primarily background questions, such as reason computer science was selected as a major, what courses were taken in high school, student access to a computer, comparisons between skill levels and abilities, preferred instructional formats, attitudes towards computers and technology, and people who influenced their choice of major.

Survey Distribution:

The survey was completed and posted to the UNCW Web server. The survey posted for current students used present tense while the surveys posted for alumni and former students used past tense verbs. In addition, formers were asked additional questions relating to possible reasons for their departure such as educational expense, specific courses, stereotypes, and family responsibilities.

Five address lists were provided. The lists included current computer science students (enrolled spring semester, 2003), computer science alumni, UNCW non-computer science alumni who had claimed computer science as a major at some point while attending UNCW, students who had claimed computer science as a major but were no longer majors and had not graduated, and inactive students. The non-computer science alumni list was combined with the former majors' list. The inactive student list was examined and those students who were inactive during the semester were viewed as currents provided their overall GPA was greater than or equal to 2.0. Inactive students, who had enrolled during 2002 and had a GPA of 2.0 or greater; but no longer had computer science listed as a major, were viewed as former students. All students who had not enrolled at UNCW before the 2002/2003 academic year were treated as former students, even if computer science was still listed as their major. This was done to try to determine if there was a particular reason this group of students had stopped attending. Inactive students with an overall GPA of less than 2.0 were not contacted. These students were not attending for reasons of academic ineligibility.

Letters describing the study were sent to all three groups informing them that participation in the study was entirely voluntary and inviting them to view the survey on-line. Each group had a unique Web address for the survey. The letter also stated the survey was anonymous and the information provided could not be traced back to them. In addition, if they elected to participate in the study and complete the survey, the Web page would forward them to a new Web page that requested their student ID. This page was from a different site so that it would be difficult to link student IDs with responses. This second page was also voluntary and entering their student ID put them in the drawing for a gift certificate. Finally, the letter informed them that they would receive reminders to complete the survey between the beginning of June and July 15. The letter also suggested that if they did not want to participate in the survey and did not want to receive any reminders, they should contact the researcher who would remove their names from the mailing list. Current computer science students received email reminders. These reminders were sent to their UNCW student email address on a weekly basis. Any e-mail reminders that were returned as undeliverable were transferred to paper mail and sent to the students via U.S. mail. Former computer science students and computer science alumni were reminded with postcards on June 15 and June 30, 2003.

A total of 243 letters were sent to computer science alumni; ten letters were returned as not deliverable. One hundred nineteen letters were sent to current computer science students with five letters returned. Of the 354 letters sent to former computer science students, 59 were returned as undeliverable.

Survey Results:

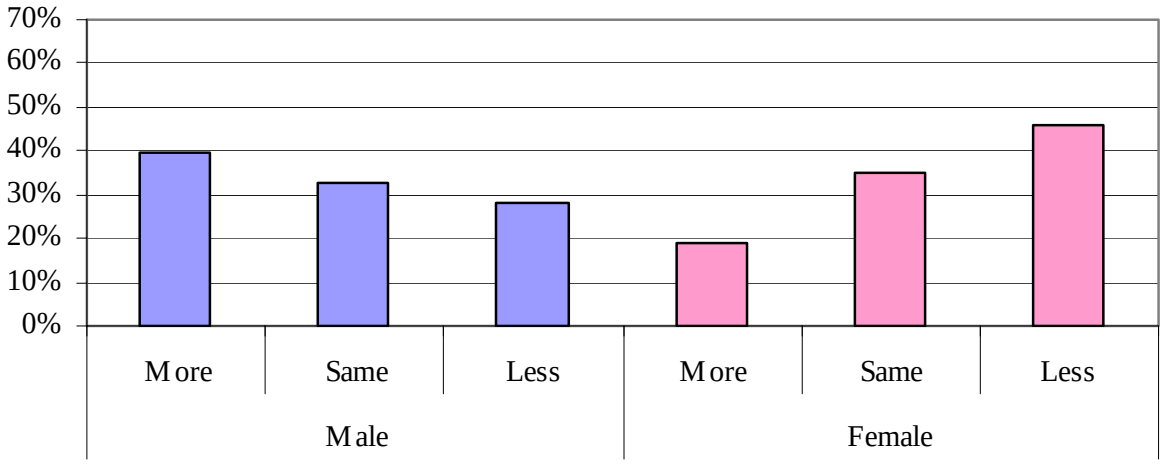
The return rates for the three groups were mixed. For alumni, out of 243 requests for participation there were 83 responses for a return rate of 34%, 20 females and 63 males. Out of the 119 requests for participation for the currents, there were 30 responses for a return rate of 24%, 3 females and 27 males. Formers had the lowest survey response rate of 36 out of 354 possible responses or 10%, 14 females and 22 males. Overall, of the 149 total responses received, 25% were from women.

Within the questions relating to previous computer experience, high school preparatory classes, people who may have influenced either positively or negatively the decision to enroll in computer science, or feelings toward the use of computers there were no differences in how the males or females responded to the questions. In addition, there was no significant difference in answers from the alumni, formers, or currents. There were noticeable differences (however, they were not statistically significant) when survey respondents were asked to compare themselves to their classmates.

Self-confidence plays a role in the retention of any student in a program. Yeung and McInerney (1999, p. 3) found that if students believe they are academically competent and their belief is reinforced by their support system, then there is a greater chance of academic achievement and success. Positive peer support can assist in academic achievement and success (Fass and Tubman, 2002, p. 561). Fass and Tubman report on a study by J. P. Bean (1983) that friends' support also influences a student's academic satisfaction in college. This finding was further supported by a study conducted by J. C. Hearn (1985, p. 424). The student's perception of ability, self-esteem, and academic achievement are also affected by their peers (Yeung and McInerney, 1999, p. 4-5).

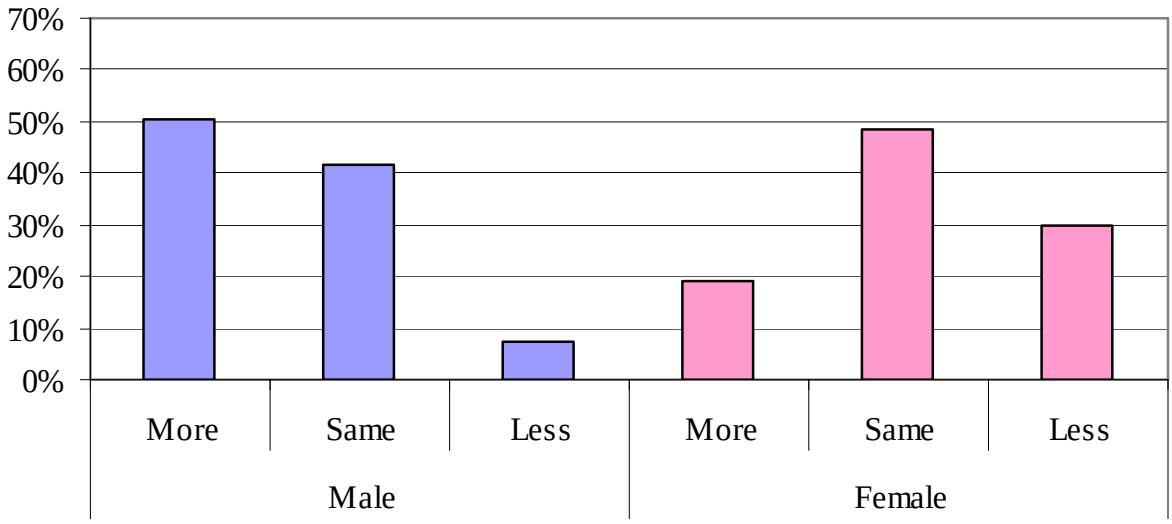
Based on what was found in the literature review, participants were asked to compare themselves, in four areas, to their computer science classmates. The first comparison was with computer experience. Overall among the three groups, more males (39.6%) felt that they had more computer experience than their classroom colleagues. More female students (46%), on the other hand, felt they had less experience. See Figure 2.

Figure 2: Comparison of perceived computer experience to other computer science students.



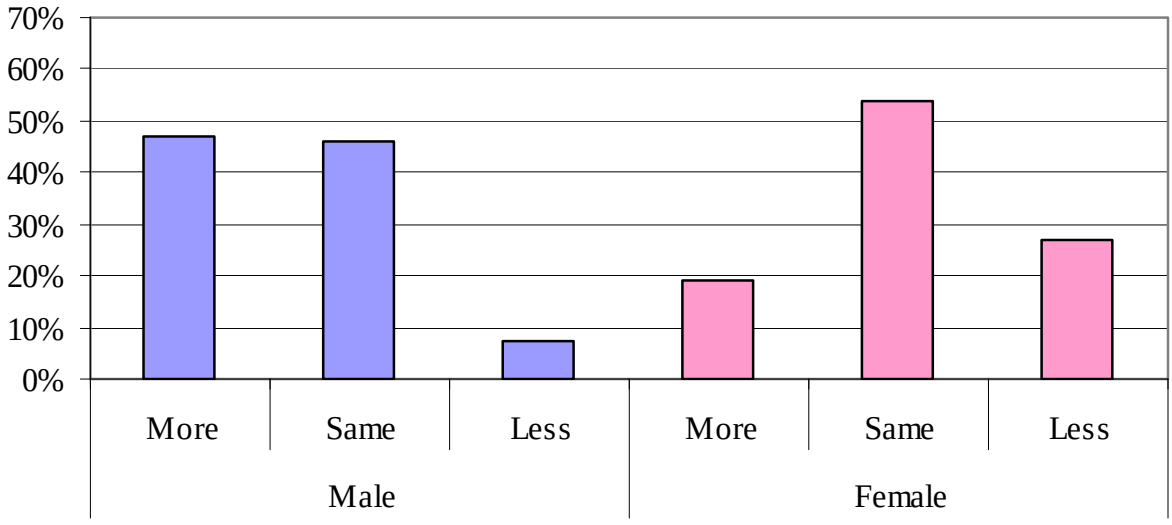
Survey participants were also asked to compare their ability to work with computers with that of their computer science classmates. In viewing their ability, males again responded they had more ability than their classmates. While the experience responses were more evenly spaced among “more,” “same,” and “less;” ability responses were much heavier between the “more” (50%) and “same” (41%) categories than the “less” (7%) category. For females, however, the level of perceived ability was primarily the “same” (49%) as their classmates. This shows a move from less experience (46%). See Figure 3.

Figure 3: Comparison of perceived computer ability to other computer science students.



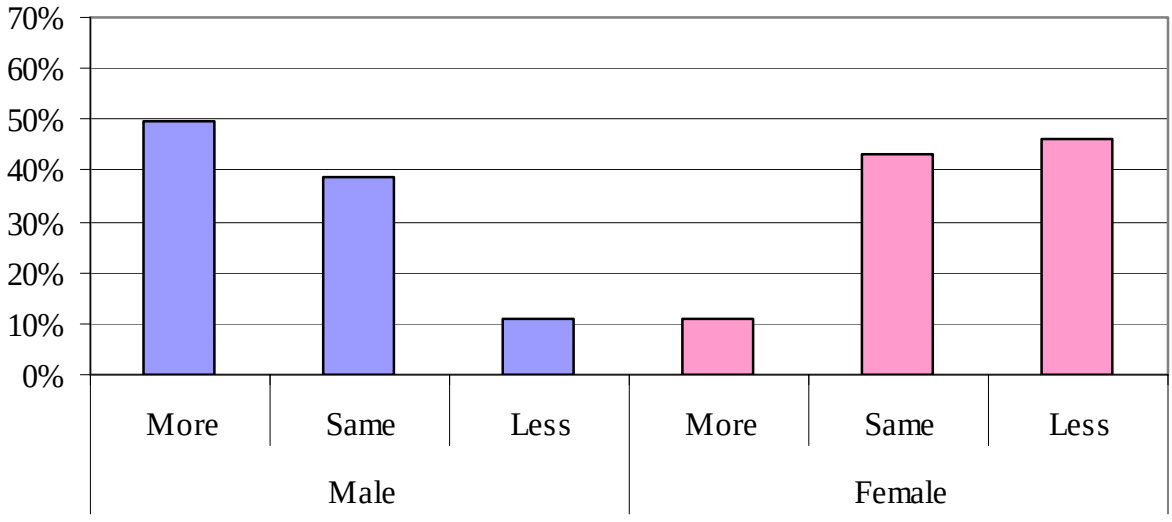
The third comparison question asked participants to compare themselves in terms of success in the computer science classroom. This question of self-perception was designed o indicate whether former computer science majors viewed themselves as less successful in the classroom, which might lead them to leave the computer science program. Both male and female responses were similar to computer ability. See Figure 4. For this question, males viewed themselves as having the same or greater success in the classroom than their peers (47% and 46% respectively, with 7% perceiving less ability). Conversely, females viewed themselves as having the same level of success in the classroom as their peers (54%); while 19% thought they were more successful and 27% thought they were less successful.

Figure 4: Comparison of perceived classroom success to other computer science students.



The final comparison question focused on students' level of confidence in the classroom. In the 1990 study, Lips and Temple (p. 101) found there was no difference between the genders with respect to computer confidence. Males (50%), however, viewed themselves as having a higher level of confidence in the classroom as opposed to females (46%) who felt they were less confident. However, an almost similar number of females (43%) felt they were as confident as their classmates. See Figure 5.

Figure 5: Comparison of perceived confidence in the classroom with other computer science students.



Based on the results from these four questions regarding self-perception in the classroom, one might expect to find females with lower grades in the classroom which might signal a reason

for the low retention rates. However, in viewing the grade point averages (GPAs) of graduates such is not the case. There are two GPAs that could be considered when comparing males and females. The first is the overall or comprehensive GPA (Figure 6) which includes grades from all courses. The second is the computer science GPA (Figure 7) which includes grades from only those courses required to graduate with a B.S. in computer science. While a comparison of both GPAs can not be a true and equal comparison (since students do not necessarily take the exact same courses with the same instructors), it is illuminating. In both cases, the GPA of the female graduates is higher than that of the male graduate.

Figure 6: Comprehensive GPAs of computer science graduates, 1999-2004.

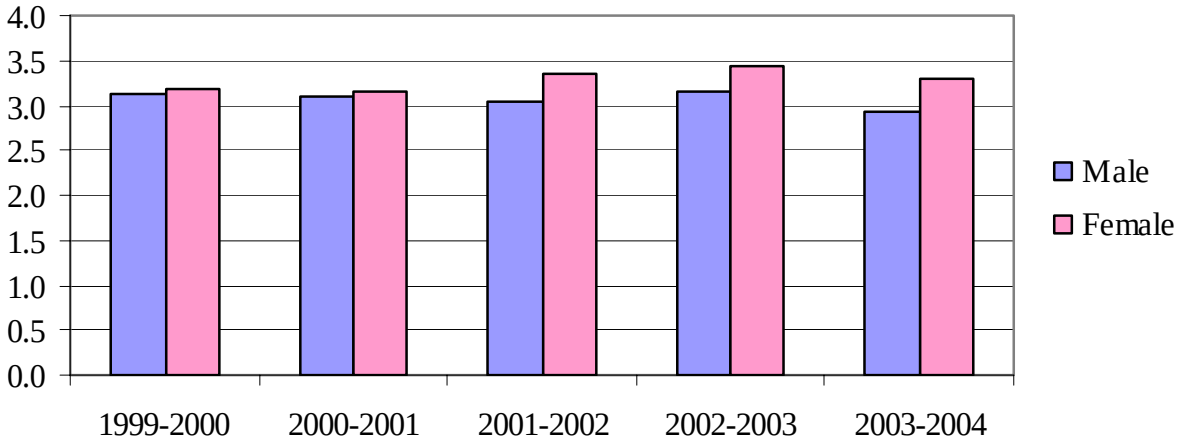
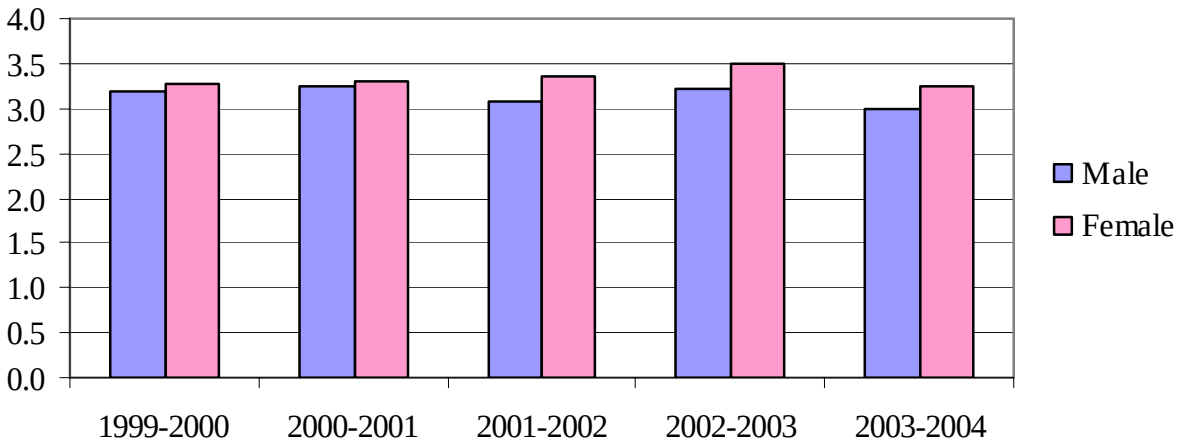


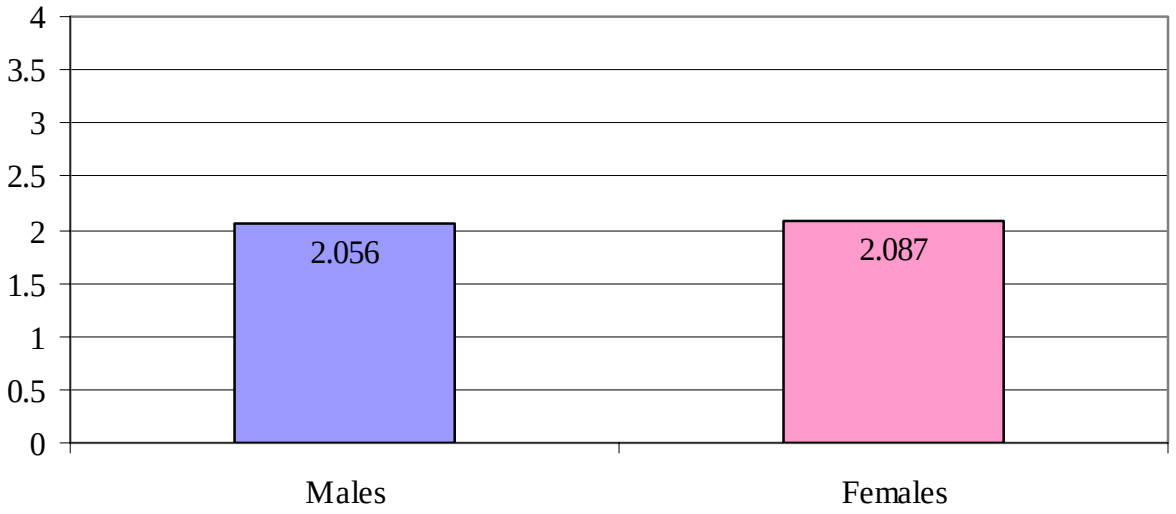
Figure 7: Computer science GPAs of computer science graduates, 1999-2004.



One of the three courses that students must complete in order to declare a major in computer science is CSC 121, Introduction to Computer Science (Java programming). Students must have a GPA of at least 2.50 on the three courses. In viewing a snapshot of this course from fall 2003, the final grade average for males and females is virtually identical with males having

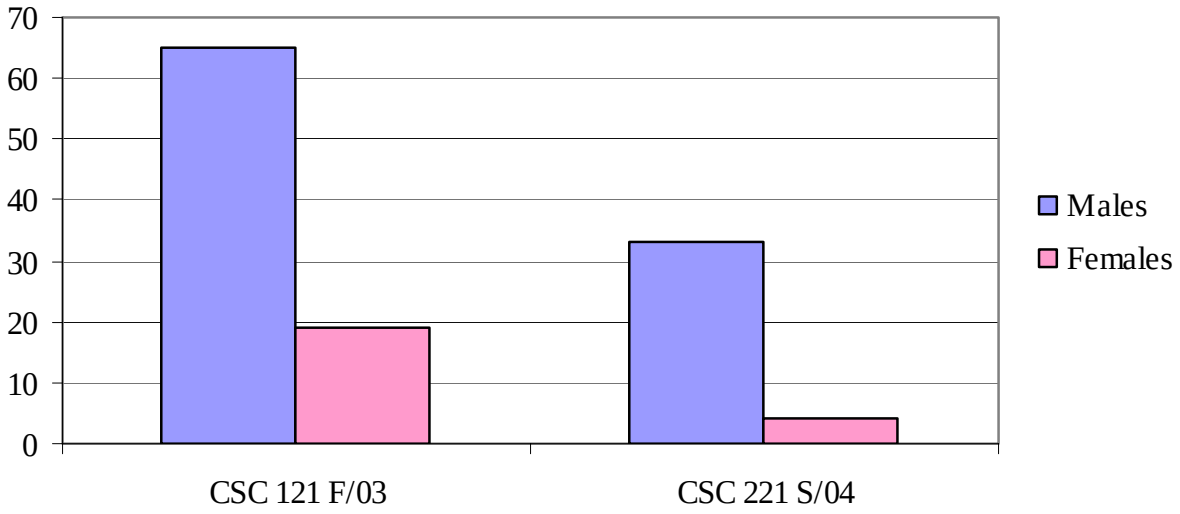
an average grade of 2.056 and females having an average grade of 2.087. This grade average is reflective of other semesters as well. See Figure 8.

Figure 8: CSC 121 Average grades



However, the retention rate of students in this class can be followed by checking the major status (those still claiming computer science as a major) and enrolling in the second semester of programming. While there is an overall 56% reduction in the number of students who take the course, female student continuation rates are reduced by almost 79%. Nineteen females completed CSC 121 and only four enrolled in CSC 221. For male students, there is a 49% reduction with only 33 of the 65 CSC 121 students enrolling in CSC 221. See Figure 9. There is the possibility, however, that some of the students who do not immediately enroll in the next semester of programming could do so at a later time.

Figure 9: Continuation rates in programming courses in computer science.



This reduction suggests that "something" happens during CSC 121 to prompt females to leave the computer science major. Their success rate as viewed by GPA signals that they are equally if not slightly more successful than their male peers. If reviewing the information provided by the National Science Foundation (NSF), the loss of females should not be occurring. NSF states that students with a high grade point average (GPA) are more likely to remain in their selected major (NSF, 1999). However, a grade average of slightly over a C is viewed as an "average" grade. While a higher percent of students with high GPAs are retained in their major, NSF data (1999) suggests that, on average, only 23% of students with average GPAs are retained. Women who receive degrees in computer field usually have high GPAs in the program as compared to males, who generally have average GPAs (Camp, 2001, p. 28). Camp also reports that females with "average" grades seldom complete their computer science degrees (2001, p. 28). This is also reinforced, again, by the literature mentioned above in relation to self-confidence. Students who receive "average" grades may not view themselves as academically competent and leave a program. When the "average" grade is combined with the self-perception of less experienced, less capable, less successful and less confident, the higher loss of female students is not surprising.

One method for signaling students about their potential for academic success comes from the instructor. The literature review found several articles on student-teacher interaction. In the classroom, it is the instructor who provides feedback on the student's academic ability (Yeung and McInerney, 1999, p. 6). Additionally, it is the instructor's support that has the strongest impact on academic achievement and self-esteem (Yeung and McInerney, p. 10). Encouragement by the instructor does have a positive affect on a female's continued participation (Dunham, 1990, p. 1).

Some studies (Long, 1987 [as cited in Baxter Magolda, 1990, p. 265]; Sadker and Sadker, 1986, p. 512) show that female college students receive less attention from instructors than do male students (Baxter Magolda, p. 259). In a summary of studies, Baxter Magolda (p. 259) reports that instructors not only give female students less attention, but when the attention is given it is of lower quality, and the female students are interrupted more often (Hall and Sandler, 1982, p. 3; Long, 1987 [as cited in Baxter Magolda, p. 265]; Sadker and Sadker, p. 515). In

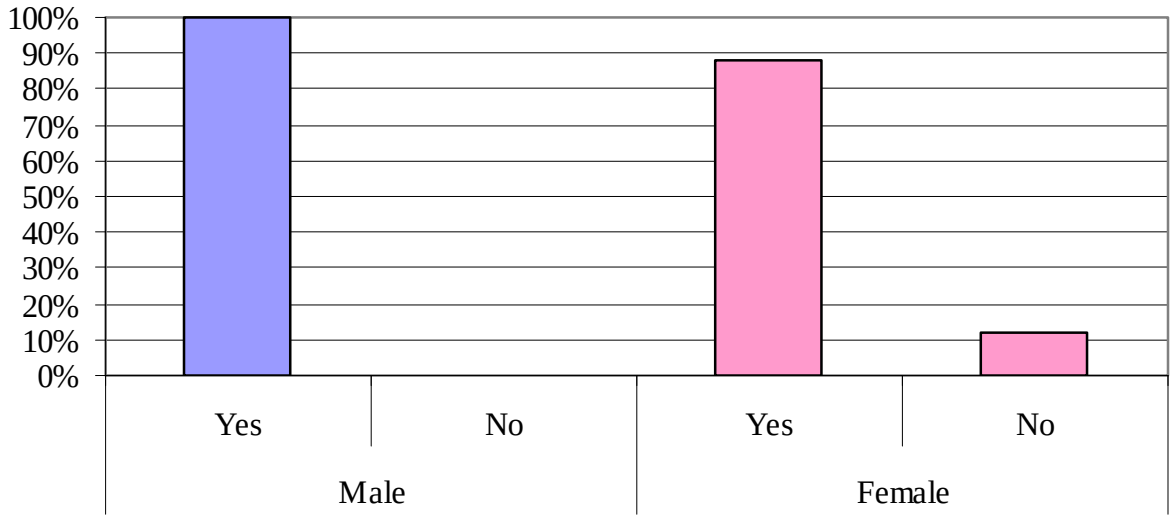
addition, both men and women faculty may look directly at a male student when he asks a question but not look at the female student who asks a question (Hall and Sandler, p. 3).

Wollam (1990, p. 23) reports that not only do instructors respond less often to female students but that they initiate fewer contacts with female students. Wollam (p. 23) also states that in a study conducted by Sadker and Sadker (1982, p. 106) the types of questions instructors ask male students are more complex and abstract. Much of this difference in the instructor's behavior to male and female students may be inadvertent (Hall and Sandler, 1982, p. 2). An instructor's biases may appear normal to both the instructor and the students and may go unreported or noted by either group (Hall and Sandler, p. 2). However, those subtle signals may make the female students feel less confident about their skills, knowledge, or abilities (Hall and Sandler, p. 2). Some of the signals that may be given include ignoring female students, calling male students by name, or using a masculine pronoun (such as "he") to represent both males and females (Hall and Sandler, p. 8-9).

Much of the difference associated with the instructor's behavior to male and female students is inadvertent (Hall and Sandler, 1982, p. 2). However, these biases may make the female students feel less confident about their skills, knowledge, or abilities (Hall and Sandler, 1982, p. 2). One of the long-term effects regarding biased behavior in the classroom is that female students may not seek assistance outside of the classroom or have less chance of developing collegial relationships with faculty (Hall and Sandler, p. 3). Based on this information, the survey asked students a variety of questions about their computer science instructors, including whether or not their instructor(s) were approachable. The questions also compared female and male instructors by asking the same question of female instructors as it did of male instructors. It should be noted at this time, however, that a high number of all respondents (33.6%) had never had a female computer science instructor. Response rates, then, are only for those students who indicated they had a female instructor in computer science.

With regard to the approachability of their female instructors, all male students who responded said they could approach their female instructors. For women, however, this was not true. While 100% of female currents said yes, only 91.7 % of female alumni and 75% of female currents felt this way. It should be noted, however, that currents, alumni, and formers may have been exposed to different female instructors and with the small number of female instructors available in computer science between 1998 and 2003 (anywhere from 1 to 3 different females taught during this time frame) that response differences may also be related to the teaching style or personality of a particular instructor. See Figure 10.

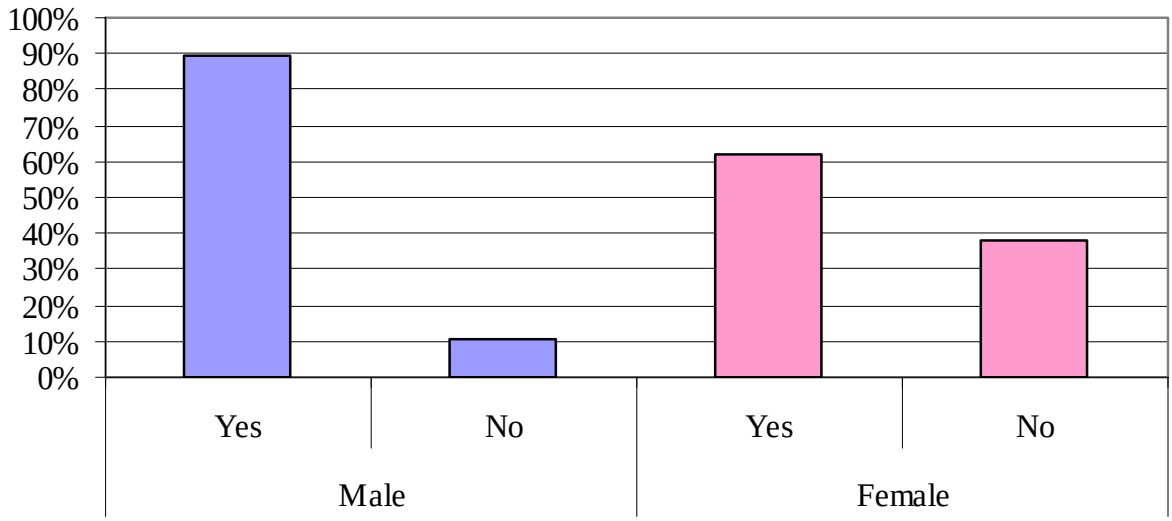
Figure 10: Approachability of female computer science instructors.



The difference is more striking when students are evaluating their male computer science instructors for approachability. A number of both males and females found their computer science instructors were not approachable. Eleven percent of all male students found their male instructors were not approachable (as opposed to 0% for female instructors); while 38% of female students found their male instructors not approachable. This difference is of greater importance in viewing that almost all students, regardless of gender, have had male computer science instructors. Since fall 1998, only 5% of the introductory course offerings were taught by a female and those sections were offered between fall 1998 and summer 1999.

When specifically looking at female formers, the percent who felt they could not approach their female instructors was more than half the respondents (57%). For male formers, the number was 20% who felt they could not approach their male instructors. Again, this compares to 0% who felt they could not approach their female instructors. See Figure 11.

Figure 11: Approachability of male computer science instructors.

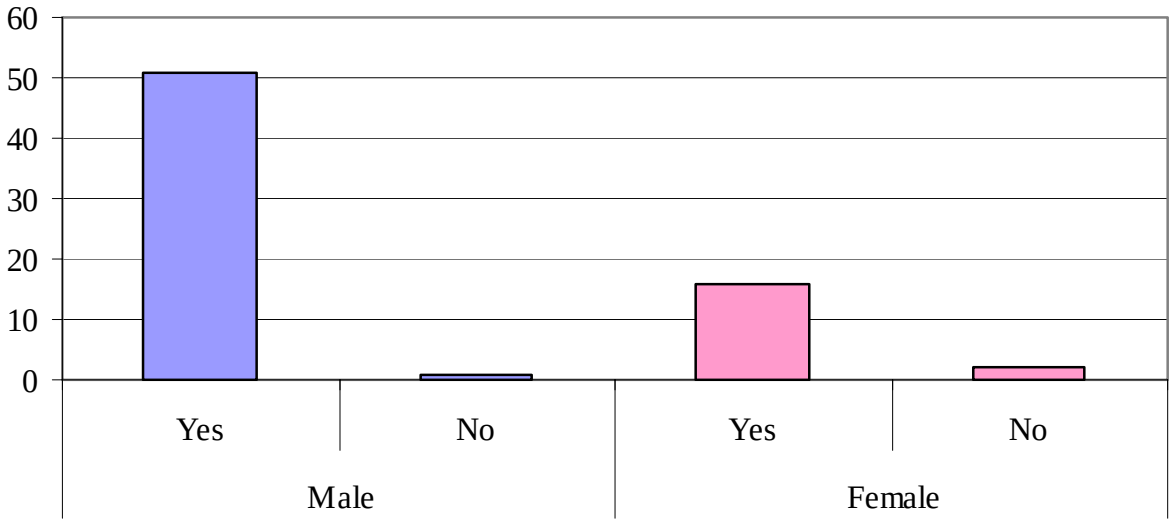


There was no noticeable difference between the male and female students on the question of why they would have approached their instructors. Reasons provided by the students were fairly consistent between them. Possible reasons included matters relating to coursework, professional reasons (such as applying to graduate school or letters of recommendation), schedule advising, and personal reasons.

The amount of attention students receive from their instructors can also affect the students' behaviors. Some of these effects may be long-term and include the level of classroom participation, seeking assistance from the instructor, switching majors, or changing career goals (Hall and Sandler, 1982, p. 3). Some studies have shown there is a difference in the amount and quality of attention instructors gives their female or male students (Long, 1987 [as cited in Baxter Magolda, 1990, p. 265]; Sadker and Sadker, 1986, p. 512). Some of the behaviors that the instructors exhibit include interrupting female students and looking directly at a male student when he is asking a question (Hall and Sandler, p. 3). In an effort to determine if the amount of attention an instructor gives to a student could have been a factor in switching majors, survey participants were asked if they felt comfortable asking their computer science instructors questions during class.

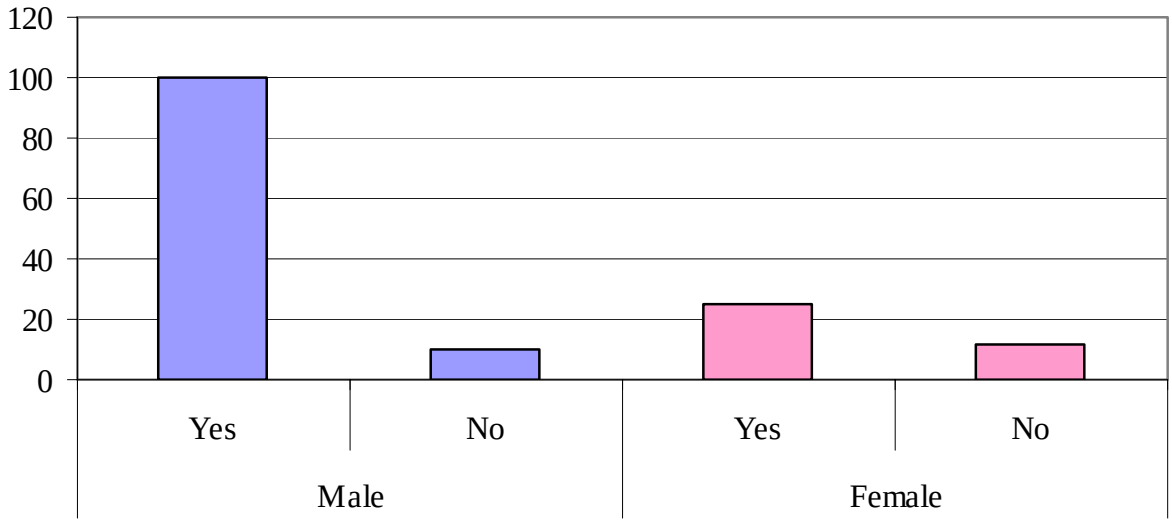
Both male and female instructors felt quite strongly that they felt comfortable asking their female computer science instructors questions. Only 3% of the respondents felt otherwise. It is the formers and the alumni who felt uncomfortable asking the questions. With the response divided between students who left the program without a degree and students who successfully completed the program it is difficult to see this playing a role in the impetus for leaving the program without the degree. See Figure 12.

Figure 12: Comfort-level asking female instructors questions.



Asking the male instructors a question, however, revealed a different response and one that, while it is not statistically significant, is statistically suggestive (G.A. = 0.1218). See Figure 13. For the entire population of respondents, 15% were not comfortable asking their male computer science instructors a question. In particular, female respondents in this group were evenly divided (19% and 19%) between feeling comfortable and not feeling comfortable asking questions. This division supports the literature finding that female students who do not have a positive interaction with their male instructors may leave programs.

Figure 13: Comfort-level asking male instructors questions.



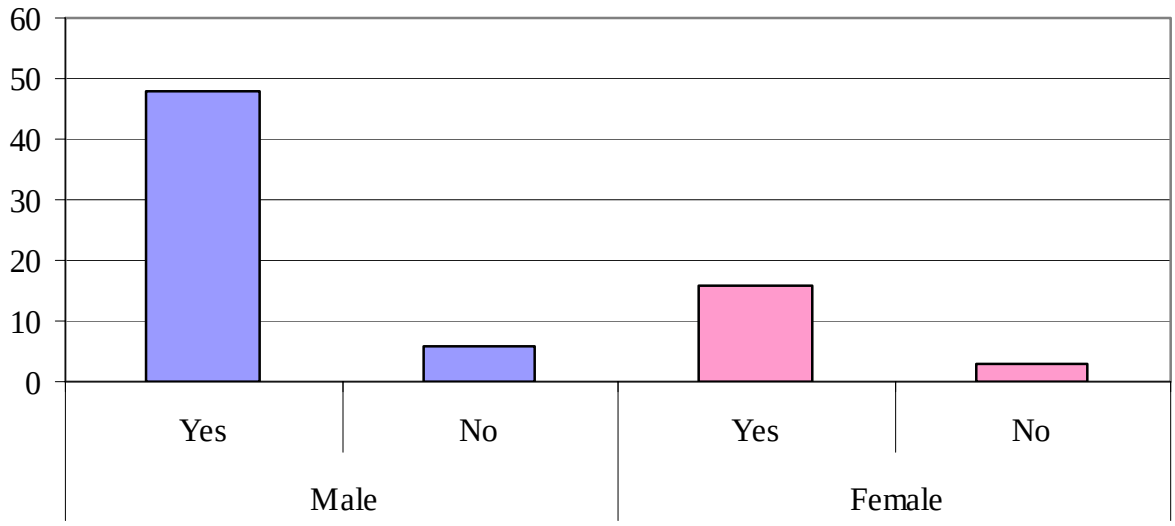
To further test how students perceive their instructors, survey participants were asked to assess their comfort level in challenging their instructors. When this question was developed, the

term “challenging” had additional connotations above the term “questioning.” The connotations associated with challenge can be found in its definition as found in the American Heritage College Dictionary.

> “1. a. To call to engage in a contest, fight, or competition. b. To invite with defiance; dare. 2. To take exception to; dispute. … 5. To question the qualifications of or validity of.” (p. 232).

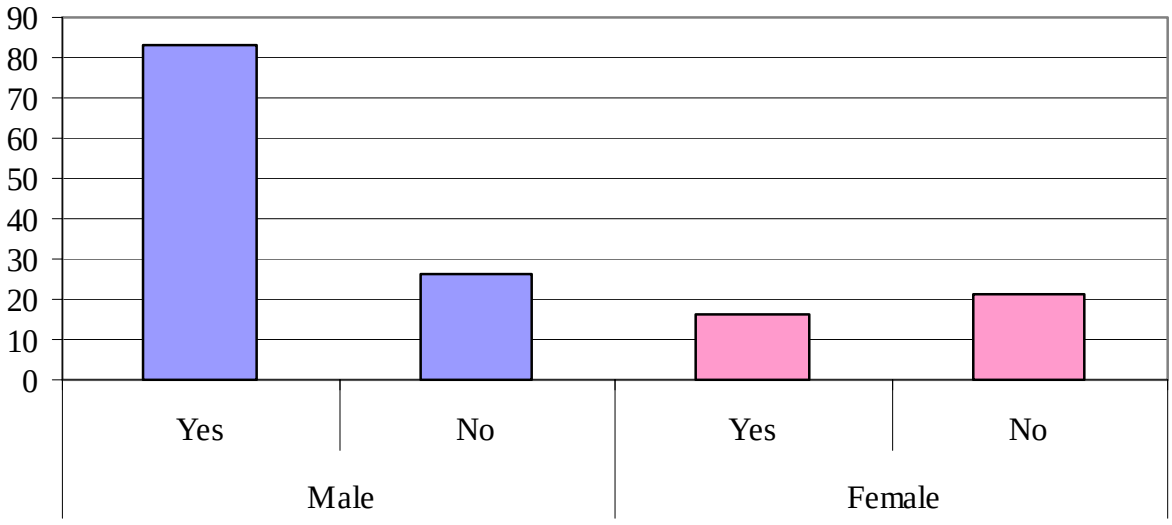
In response to the comfort level towards challenging their female computer science instructors, 66% of the male students comfortable challenging their female computer science instructors. Eighty-four percent of the females were comfortable challenging their female instructor. See Figure 14. Response rates between male and female students are neither statistically significant nor statistically suggestive.

Figure 14: Comfort-level challenging female instructors.



Again, for male instructors there is a difference on this issue of challenging the instructor. While it is not statistically significant, there is a suggestion of a difference. While it is apparent that males and females of all three groups were comfortable challenging their female instructor; fewer of them were willing to do the same toward their male instructors. While only 6% of the total population of respondents were uncomfortable challenging female instructors, 32% were uncomfortable challenging male instructors. Without further data or questioning of the respondents but based on the definition of the term “challenge,” these results could be construed to mean that either the female instructors’ capabilities were deemed questionable by the students and that male instructors capabilities are held in higher esteem or that female instructors may be more amenable to this type of exchange in the classroom. See Figure 15.

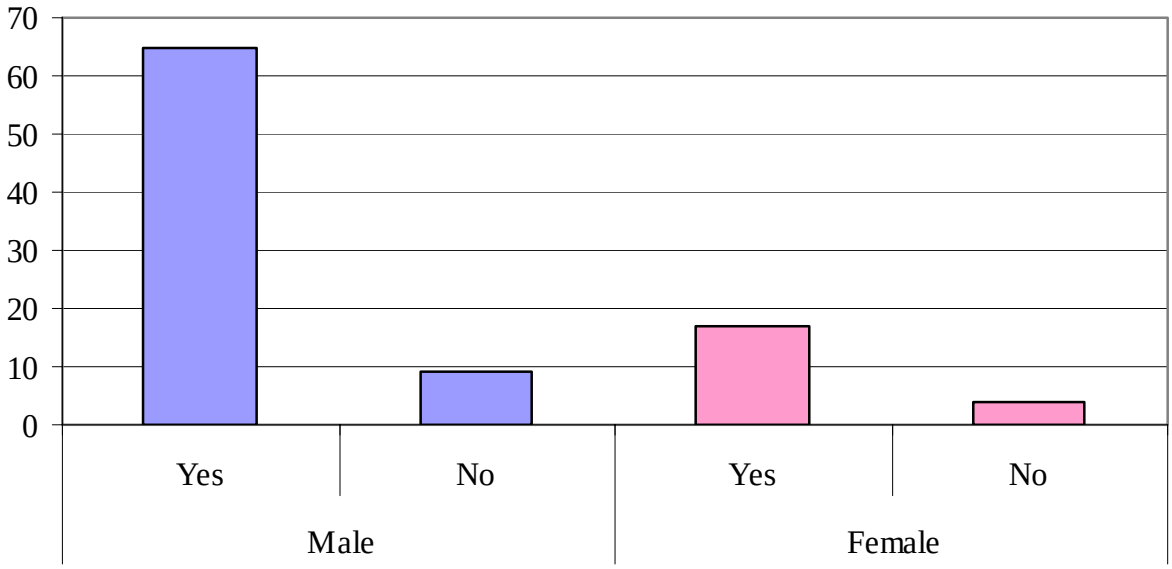
Figure 15: Comfort-level challenging male instructors.



In many of the studies regarding the differences between male and female students, it has been found that the instructor's behavior can influence whether or not a student remains in a course or a program. Much of the behavior of instructors towards their students may be inadvertent (Hall and Sandler, 1982, p. 2). While the biases and behavior may appear normal, instructors can send subtle signals that may make the female students feel less confident about their skills, knowledge, or abilities (Hall and Sandler, p. 2). Based on this research, survey participants were asked a series of questions aimed at determining if computer science faculty give any of these subtle signals. The first question asked if the instructor used gender-neutral terms in the classroom. There were no differences between the genders when they were compared as a whole.

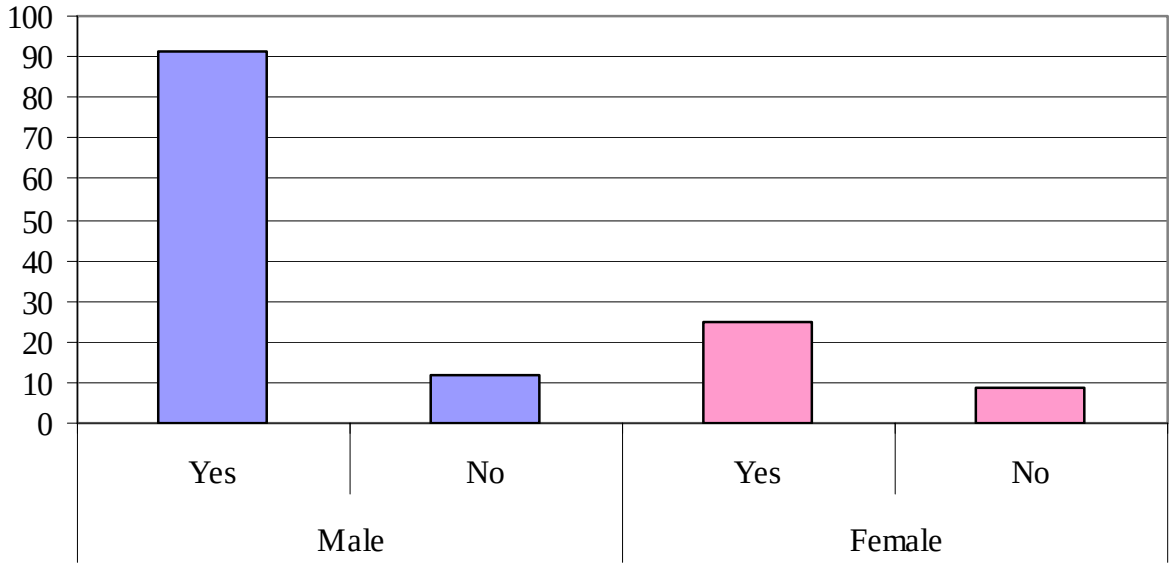
A comparison among the groups suggests that there is a difference in perceptions; however, the difference appears to be the opposite of what would be expected from the literature search. Of the remaining two-thirds of respondents who had had a female instructor, it is the current computer science and the computer science alumni groups who believed their female instructors did not use gender-neutral terms and not the former computer science major males or females who believed their female instructors did not use gender-neutral terms. See Figure 16. There is no statistical significance or suggestion between the male and female student responses; although it is difficult to make an actual comparison because of the low number of females enrolled in the program and who responded to the survey.

Figure 16: Female instructors use of gender-neutral terms.



When asked the same question of their male instructors, the results were not significantly different. Within the entire population of survey respondents who answered the question, 14.1% of the students answered that their computer science male instructors did not use gender-neutral terms. See Figure 17.

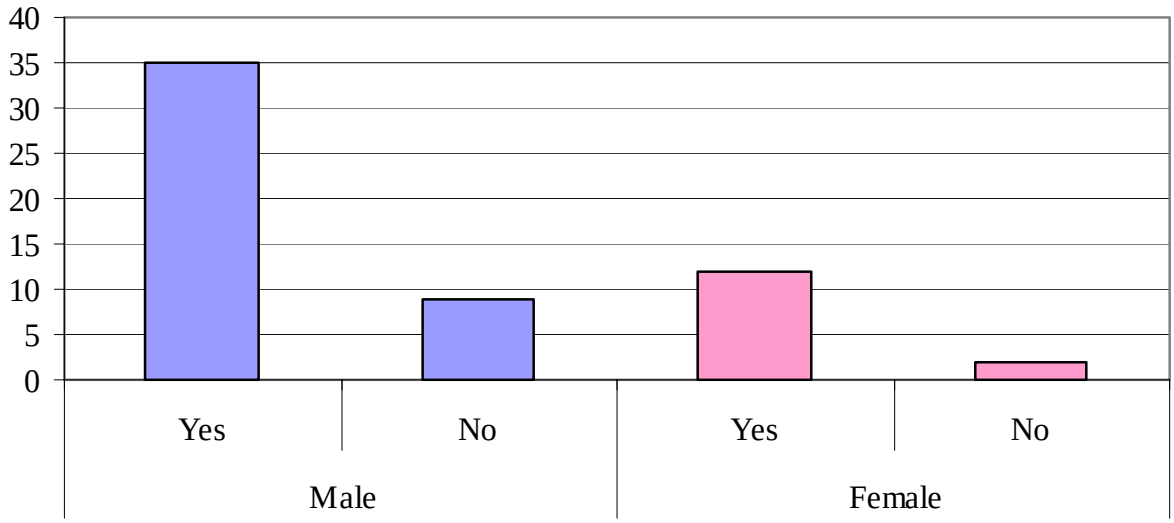
Figure 17: Male instructors use of gender-neutral terms.



Another subtle signal that female students may receive from their computer science instructors comes through the instructor's use of non-gender-neutral images or visuals presented during class. Students were asked if their female instructors used female and male images

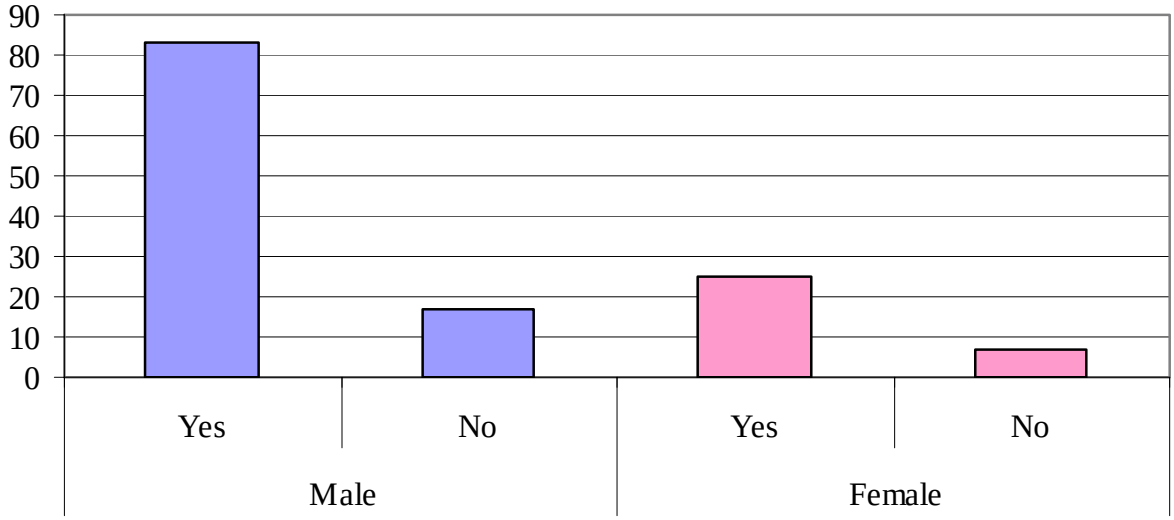
equally when images or graphics were used during class time. Within the population of students who had a female instructor and responded to this question, 19% felt that their female instructors did not use gender-neutral images. See Figure 18.

Figure 18: Female instructors use of gender-neutral images.



For male instructors, however, the results are only slightly different. Within the entire population of survey participants, 18% felt that their male instructors did not use gender-neutral images. A slightly better statistic than for female instructors (19%), but not significantly better. See Figure 19.

Figure 19: Male instructors use of gender-neutral images.



Based upon the results of the survey and the differences among the three groups, there do appear to be differences in student perceptions toward computer science instructors. Whether these perceptions are accurate or not cannot be determined by this survey; however, there are enough differences or gaps between female and male instructors and female and male student interactions to suggest there may be differences in student perceptions that could be linked to departure rates for students.

Conclusion:

The purpose of this study, then, was to determine if there was any difference between the perceptions of students who remained in the program and those who left the major toward faculty in the department. In addition, the researchers wanted to find out if these perceptions affected whether a student (in particular, female students) remained in the program or transferred to another major.

Although survey participants were asked additional questions to determine if there were other factors that may have played a role in their departure from the program, it was questions that focused on the instructor that were of primary interest to the researchers. The questions included whether the instructor was approachable, used gender neutral terms or images in the classroom, and whether the student felt comfortable asking the instructor questions or challenging the instructor's knowledge in the classroom.

An analysis of responses among the three groups revealed there were no differences for reasons why they initially pursued computer science or the people who may have played an influential role in that decision. A gap analysis of responses with regard to how the survey participants viewed the department faculty in terms of approachability and gender-neutrality revealed potential reasons for the loss of female students in the major. While the answers are the perceptions of the survey respondents, it is the students' beliefs, perceptions, and opinions that play a role in any decisions they make.

Not only were the above listed as possible factors, there is no study that pinpoints any one reason as the cause for the higher loss of female students. Whatever the explanation, it has also been suggested that rather than one particular reason for the lack of retention, there may be a combination of reasons for the departure (Sanders, 1993, p. 32). Throughout the evaluation of the program, the critical focus was on the student's perception of events or actions in the department. Faculty actions could, for example, be gender-neutral (use of images or pronouns, for example); however, student perceptions could view them otherwise since perceptions are highly subjective. This study did not include evaluating the faculty member's lectures or presentation materials.

It should be stressed, again, that the results of this study are entirely based on student perceptions. This is no data that supports or disclaims these findings. An empirical study of the behaviors and actions of the computer science faculty has not occurred.

Recommendations:

As a result of this study, several recommendations can be made.

1. Lesson plans should be re-evaluated periodically by the instructors, as should any multimedia instructional presentations or department publications, for gender-neutrality. Attention should be given to use of gender-specific pronouns and to images. If gender-specific images must be used, equal attention should be given to both genders.

2. To determine if faculty are indeed using gender-neutral images or terms in the classroom, an additional review by someone other than the instructor of course materials should be conducted. This could easily be added on to the periodic peer assessments that occur during classroom visits.
3. Additional support could be provided with the use of peer advisers. With the low number of females entering the program, it is important for them to see other females succeeding in the program. Frequently when students first start the program they do not know any other students and, if they are female or minority students, they may not see any other female or minority students and, consequently, feel isolated.
4. Currently, the department advises students on a once/term basis. To retain students, the department should consider implementing other advising opportunities. This could include having one member of the department or a few members of the department specifically assigned to advise incoming students. This would identify faculty members, to students, who would be there specifically to help with general questions. It could also identify a specific office where students could go at anytime during the school day to get advising assistance. Santa Rita and Bacote's research (2000, p. 161) find that student retention in a program is higher with support.

Additional research should also be conducted on the loss of students from the program. At the end of each semester, students who have transferred to another major or program at UNCW should be identified and contacted for an exit interview to determine why they left the program. This exit interview could be conducted with a member of the department faculty or through an on-line survey.

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