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# GENDER DIFFERENCES IN COMPUTER ATTITUDES AND USE AMONG COLLEGE STUDENTS

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**ABSTRACT**

In this study we examined the gender gap in computer attitudes and use based on a sample of 202 college students. We surveyed the students' attitudes in relation to gender, experience, and parental encouragement. Students responded differently in regard to attitudes and experience: females were less interested in computers and less confident than males; males were more experienced. Further analysis of the students' responses showed that one semester of computer training improved their attitude toward computers. The results are discussed in terms of students' precollege computer experience and parental behavior.

## INTRODUCTION

Women pursue educational and occupational careers in computer-related fields less frequently than men. In recent years the percentage of females studying computer science at various educational levels has declined nationwide, at a time when the proportion of women at the college level outnumbers the proportion of men [1]. As the statistics show, the percentage of females entering the job market is increasing much faster than that of males [2]. If the United States is to maintain its competitive position both nationally and internationally, at a time when jobs requiring scientific and technical knowledge are increasing, it must educate more women to be competent in scientific and technical fields.

## REVIEW OF LITERATURE

The literature reveals that boys are more interested in computers than girls, and enjoy working with them more [3-5]. Shashaani, for example, in her study of 1,730 high school students, found that boys were more enthusiastic about working with computers [5]. Krendle, Broihier, and Fleetwood observed that among

students in grades four through ten, boys were significantly more interested in computers [6]. This gender discrepancy did not diminish over time as students gained experience with computers. Massoud reported that male students had more computer-related interests and more confidence in their ability to use computers than did female students [7]. According to several studies, males at the college level agree more strongly than females that computers are enjoyable [8, 9].

Research has also shown that male students express more confidence than female students about their ability to use computers, and less anxiety about working with them. Voogt, in a study of 873 students from ages twelve to sixteen, found that boys had more confidence in their efficacy than did girls and less anxiety in dealing with computers [10]. Chen reported that among high school students, males were more self-confident than females about their abilities with computers [11].

The gender differences in confidence did not disappear even after controlling for the similarity in the amount of experience. Makrakis found that Japanese high school girls had less sense of self-efficacy than boys in their personal ability to learn about computers [12]. Wilder, Mackie, and Cooper noted that at the college level, females were less comfortable than males in working with computers, even with similar exposure to computers and the same amount of experience [9]. Similarly, Miura conducted a study at the college level and found that male students had higher self-efficacy than female students with respect to computing [13]. She also observed a correlation between the self-efficacy score and willingness to take a computer science course. Leveson believes that this low level of self-confidence among college students is related to the lack of female role models: "White males have lots of successful men with whom they can identify—they benefit from the self-reinforcing concept that they 'belong.' On the other hand, women and minorities have few role models who have been successful before them, and they often feel like outsiders" [1, p. 5].

Studies have also found that men hold more gender-typed views about computer users than do women. More males than females believe in men's superiority in computer competency. Collis [14], Levin and Gordon [15], and Smith [16] reported that female students agreed more consistently than comparable male students that the genders have equal ability in computer use. In a study of American and Soviet children's attitudes toward computers, Martin, Heller, and Mahmoud found significant gender differences in drawings by computer users: boys most often drew males, and girls most often drew females [17]. Francis, however, in her study of 378 first-year undergraduate students, found little evidence that computer use was stereotyped as a male domain [18].

Males and females also have different attitudes regarding the value of computers. Koohang found that male college students rated computers as more useful than did female students [19]. He also found that students who had more experience with computers perceived computers as more valuable. Fetler reported that girls in his survey were more pessimistic than boys about the use of computers to

help them obtain a better job [4]. Campbell found that students' perceptions about the usefulness of computers in their education and career plans were the most influential variable for predicting enrollment in computer courses [20].

The gender differences in computer attitudes may be influenced by many factors. Several studies suggested that women's negative attitude and lower achievement in working with computers are related to less exposure, and that the discrepancy between men's and women's attitudes will disappear or at least will be reduced if the computer experience variable is controlled [11, 21, 22]. Men in general have more access to computers in school and at home [15, 23], and attend more computer classes and computer camps [24]. The differences between males' and females' participation in computer classes increases in programming courses and advanced computer classes [25]; women are less competent than men in computer programming courses [26]. Studies by Lockheed, Nielson, and Stone revealed that in secondary schools, female students spend less time than male students with computers, and fewer enroll in computer classes [27]. Computers are found more often in male students' homes, and the primary users of home computers are males [22, 28].

Ownership of home computers has a positive effect on students' attitudes and academic performance [29]. Ogletree and Williams found that individual computer ownership was associated positively with computer attitudes and with higher self-efficacy scores among high school students [30]. Taylor and Mounfield reported that taking a high school course in programming was one of the most reliable indicators of success in college computer science [31, 32]. Shashaani's study revealed that among high school students, computer use was related positively to interest in computers and to the perceived value of computers [22]. Badagliacco reported that undergraduate men had more computer experience and more favorable attitudes toward computers than did undergraduate women [33]. The nature of the computer experience is also important: Koohang and Byrd found that students with strong backgrounds in programming had more positive attitudes toward computers [34].

Other studies have paid more attention to the social and cultural environment to explain the gender differences in computer attitudes. Advocates of the socialization theory believe that differences between men's and women's behaviors and attitudes are linked to differences in socialization: people's perceptions reflect their social experiences with significant others, including parents, teachers, and peer groups. Parents and teachers, both as role models and as important socializers, play a crucial role in socializing boys and girls to have different expectations and values regarding various school subjects [35, 36].

According to Gerver, many teachers and career advisors still perceive science and technology, including work with computers, as more appropriate for males and so do not encourage females to participate in these fields [37]. Studies using videotapes and direct observation of college-level computer science classes revealed that teachers treated female students differently from male students, and

that most teachers were not aware of this behavior [1]. According to other studies, many women felt that their advisors had not given them adequate advice on careers and choice of subject. They believed that their advisors had encouraged them to choose traditional fields such as nursing and teaching, rather than non-traditional fields [38]. As Sanders states [39], "Singly, these behaviors probably have little effect. But when they occur again and again, they give a powerful message to women: they are not as worthwhile as men nor are they expected to participate fully in class, in college or in life at large" [40, p. 10].

Females' lack of interest and low self-confidence regarding computers are related, to some extent, to their parents' behavior and expectations. Parents have different expectations for their sons' and their daughters' educational and occupational careers. They believe that mathematics and science are more important for their sons, and reading and social science for their daughters [41-43]. Boys, more than girls, are encouraged by their parents and peers to engage in computer activities [44]. Parents may convey their expectations to their children by expressing their beliefs about the children's ability or about the importance and the difficulty of various school subjects [45]. Leung found a positive relationship between adults' beliefs or expectations for their children's achievement behavior and the children's actual achievements [46].

This survey of the research leads us to conclude that the issue of gender differences in attitudes is multidimensional. With this assumption in mind, we designed the present study to examine the gender difference in attitudes and in the use of computers among undergraduate college students. Most of the studies on this subject were conducted at the high school level. Here, however, we attempted to study the factors that may create a similar gender gap at the college level. On the basis of existing research and theory, we hypothesized that gender differences exist in students' attitudes toward computers. Further, because prior research has shown that computer experience influences computer attitudes, we predicted that completion of a one-semester computer science course would have a positive effect on students' attitudes and participation.

## METHODS

### Subjects and Procedures

The sample consisted of 202 undergraduate students (87 males and 115 females) who were enrolled in 1993 in one of the seven sections of "Elements of Computer Science," an introductory computer science course offered at a private urban university located in Pittsburgh. The participants came predominantly from upper- and middle-class families. Their ages ranged from seventeen to twenty-six, with a median age of twenty-one. The students were majoring in various fields such as computer science, mathematics, pharmacy, communication, sociology, and political science.

"Elements of Computer Science" is an introductory computer science course, which was required for all participants in this survey. Classes meet three hours per week for fifteen weeks. Approximately 50 percent of the course consists of hands-on instruction: several projects, including work in word processing, databases, spreadsheets, electronic mail, and the Web, are required for completion. The remaining 50 percent of the course is concerned with computer theory.

At the beginning of the semester, before projects were assigned, we administered a questionnaire to measure students' backgrounds and attitudes regarding computers. After fifteen weeks of training and use of computers for various projects, we administered the questionnaire again to determine the effects of learning and using computers on the students' attitudes. Participants were assured that their responses would be anonymous.

## Instrument

The questionnaire contained items that we obtained from a modified version of the instrument used in our previous research to collect data in three major categories [5]:

1. Computer attitudes. We used a Computer Attitude Scale to measure students' attitudes toward computers. To facilitate the data analysis, after we computed the man score for each item separately, we grouped the items into four subscales: computer liking (6 items), computer confidence (7 items), computer usefulness (6 items), and computer stereotype (4 items). Both positively and negatively worded items were used, although we recoded the values of the negative questions before grouping them. The higher the score, the more positive the attitude toward computers. Additional questions were designed to survey the students' perceptions of their parents' gender-types views toward computer users and to learn how strongly their parents encouraged them to become involved with computers. The survey used a 5-point Likert-type scale (strongly disagree = 1; strongly agree = 5). We calculated the alpha reliability for each subscale; alphas ranged from .70 to .90, indicating high internal consistency.
2. Computer experience. To assess the students' experience with computers, we collected data on computer courses that students may have taken in high school, frequency of computer use in high school, home computer ownership, and the primary user of home computers.
3. Demographic information. We also collected data on the students' age, sex, and academic class status, and on the composition of the class.

## Data Analysis

To measure men's and women's attitudes toward computers we conducted four unpaired *t*-tests (for computer liking, confidence, usefulness, and stereotype) using the pretest scores and four additional unpaired *t*-tests using the posttest scores. We also employed the chi-square test to determine any gender differences

in relation to precollege computer experiences. We calculated Pearson correlations to measure the associations between each of the independent variables—computer experience and parental behavior—and the dependent variable, computer attitude.

## RESULTS

### Students' Attitudes toward Computers

The unpaired *t*-tests on pretest scores yielded a significant effect for gender on three computer subscales. Males scored higher than females in liking to learn about computers, enjoying work with computers, and considering computers exciting. With regard to confidence, females felt more uncomfortable with computers, and feared them more. They believed that the computer is hard to learn, and had less confidence than men in dealing with them.

Although both males and females tended to agree with the statement on the gender equality of computer users, the score was higher for female students. Females strongly agreed with the statement "Females have as much ability as males when learning to use computers," and strongly disagreed with the statement "Studying about computers is more important for men than for women." In general the gender differences in relation to three of the above subscale attitudes—computer liking, confidence, and stereotyping—were significant.

We found no significant differences between men and women in respect to the perceived usefulness of computers. Both genders were aware that knowledge of computers is important for obtaining a job, saves time and work, and is useful for data processing and problem solving (see Table 1).

### Students' Experience with Computers

Questions about experience with computers revealed that males had more experience than females: 58 percent of males but only 40 percent of females reported that they already had some experience. More males than females

**Table 1.** *T*-Test for Pre-Computer Attitudes-Scores

| Computer Subscales | Male Mean (*SD*) | Female Mean (*SD*) | *T* | *P* |
|---|---|---|---|---|
| Computer liking | 3.72 (.73) | 2.90 (.94) | 6.40 | .001 |
| Computer confidence | 3.98 (.81) | 3.03 (1.0) | 5.22 | .004 |
| Computer usefulness | 3.79 (.59) | 3.85 (.62) | 1.72 | .08 |
| Gender-equality of computer users | 4.03 (.76) | 4.20 (.58) | 3.91 | .01 |

reported having taken computer courses in high school; males on average, had taken more courses than females. Among those who had taken computer science courses, males reported taking more programming courses than females. We also found that males on average, spent more hours per week in high school computer labs than did females.

A higher percentage of men than of women reported having computers at home, and there was a significant difference in the primary user's gender: about 70 percent of home computer users were males and only 25 percent were females. The gender of the remaining 5 percent was not identified (see Table 2).

## Parents' Perceived Behavior toward Computers

Both males and females in our sample tended to agree that their parents, especially their fathers, believed that the computer is more appropriate for males than for females ($\bar{X}$ = 3.75 for fathers, $\bar{X}$ = 3.59 for mothers). The difference in perception of parental attitudes toward computers was not significant by gender. Males agreed more strongly than females that they were encouraged by their parents to learn about computers ($\bar{X}$ = 4.0 for males, $\bar{X}$ = 2.76 for females). Both male and female students tended to agree with the statement "My parents' attitudes have been important in my decisions about the classes I choose" ($\bar{X}$ = 3.68 for males, $\bar{X}$ = 3.85 for females).

To further examine the relationship between computer attitudes (on one hand) and computer experiences, parental attitudes, and parental encouragement (on the other), we performed Pearson correlations. In general we found a positive correlation between students' prior experience with computers and their attitudes. Students who had knowledge about and experience with computers 1) expressed more interest in computers, 2) had more confidence in their ability to work with computers, 3) believed more strongly that the genders were equal in computer

**Table 2.** Pretest Scores for Students' Computer Experience

| Experience | Male | Female |
|---|---|---|
| Having any experience or knowledge about computer | 58% | 40% |
| Taking computer courses in high school | 45% | 35% |
| Average number of computer courses taken in high school | 1.5 | 1.0 |
| Average hours of computer use in high school per week | 2.0 | 1.2 |
| Having computers at home | 66% | 55% |
| Primary users of home computer user | | |
| Males 70% | | |
| Females 25% | | |
| Others 5% | | |

$p < .05$

ability, and 4) agreed more strongly that the computer is useful for the individual and society. We obtained similarly positive correlations between computer attitude subscales (on the one hand) and taking computer-related courses and using computers in high school (on the other). We observed a small but positive association between computer ownership and liking computers, computer ownership and confidence in using computers, and computer ownership and perception of computers' usefulness (see Table 3).

In regard to perceived parental attitudes, we found a positive correlation between male students' computer interest and confidence and parents' perceived gender-typed views about computer users. That is, those male students who perceived that their parents considered the computer more appropriate for males were more interested in computers and more confident than were other male students.

Among female students, parental attitudes were related negatively both to their daughters' interest in computers and to their confidence in their ability to use computers. Female students who perceived that their parents considered the computer more appropriate for males were less interested in computers and had lower confidence in their ability to use computers than were other female students.

We obtained a positive correlation between parental encouragement and students' attitudes toward computers. Both male and female students who received more encouragement from their parents to become involved in computers were more interested in computers, had greater self-confidence, and were more aware of the benefits of computers in their daily life (see Table 4).

**Table 3.** Correlations between Computer Attitudes and Computer Experience

| Experience | Computer Liking | Computer Confidence | Computer Usefulness | Gender-Equality of Computer Users |
|---|---|---|---|---|
| Having experience or knowledge | .35** | .22** | .27** | .18** |
| Have taken computer course(s) | .14* | .22** | .10* | ns |
| No. of courses taken | ns | .10* | .15* | ns |
| Hours using computer in high school | .16* | .25** | .18* | ns |
| Hours using computer in college | .23** | .30** | .19* | ns |
| Computer ownership | .12* | .14* | .19* | ns |

*$p < .05$
**$p < .01$

**Table 4.** Correlations between Parental Attitudes/Encouragement and Students' Attitudes

| Computer Attitudes | Fathers' Gender-Typed View | Mothers' Gender-Typed View | Parental Encouragement |
|---|---|---|---|
| Male: | | | |
| Computer liking | .18** | .16* | .36** |
| Computer confidence | .26** | ns | .36** |
| Computer usefulness | ns | ns | .22** |
| Gender-equality of computer users | ns | ns | ns |
| Female: | | | |
| Computer liking | −.29** | −.31** | .45** |
| Computer confidence | −.22** | −.35** | .39** |
| Computer usefulness | ns | ns | .18* |
| Gender-equality of computer users | ns | ns | ns |

*$p < .05$
**$p < .01$

To examine the effect of one semester of computer science instruction on students' attitudes toward computers, we performed four unpaired *t*-tests, using the posttest scores. The results showed that by the end of the semester, both male and female students had more positive attitudes toward computers. Students expressed more interest in computers, had more confidence about working with computers, and agreed more strongly that the computer was useful for them. Their belief about gender equality among computer users did not change much (see Table 5).

The students' performance in the course, which was measured on the basis of their final grades, showed that females' grades were not affected by their lack of confidence in learning and working with computers or by their lower level of interest. Although females more than males perceived computer science as difficult and feared being around computers, they performed much better in the course than did males. The mean score was 3.1 (B) for females and 2.5 (C) for males, out of a possible 4.0 (A).

The posttest also revealed the extent of computer use during the semester. Both males and females used computers more than three hours a week, with no significant gender differences in the number of hours they spent. Males spent an average of 3.2 hours per week working with computers; females spent 3.4 hours per week. It seems that the amount of computer use required to complete

**Table 5.** *T*-Test for Post-Computer Attitudes-Scores

| Computer Subscales | Male Mean (*SD*) | Female Mean (*SD*) | *T* | *P* |
|---|---|---|---|---|
| Computer liking | 4.10 (.85) | 3.70 (.35) | 3.40 | .01 |
| Computer confidence | 4.12 (.76) | 3.63 (.96) | 4.95 | .003 |
| Computer usefulness | 3.98 (.68) | 4.00 (.75) | 1.12 | .06 |
| Gender-equality of computer users | 4.00 (.75) | 4.25 (.63) | 3.85 | .01 |

the project for the course eliminated the difference between the genders on this variable.

## DISCUSSION

The results of this study include several important findings. The first is support for the hypothesis that there are significant gender differences in computer attitudes and experience, based on a sample of college students. Males were more interested in computers than were females, and had more self-confidence in working with computers. Despite negative feelings about their own ability and interest in learning about computers, female students did not associate stereotypes with computer users. They perceived women in general to be competent computer users, an example of what Collis calls women's dual perspective, or the "we can, but I can't" paradox [47]. According to earlier studies males believed that computers were more appropriate for males [10, 23]. Males in our sample, however, did not hold gender-typed views about computer users; this finding is encouraging. Similarly, both males and females in our study tended to agree that the computer is valuable in daily life. This result is inconsistent with those of Fetler [4] and Wu and Morgan [48], who found that girls were more pessimistic than boys about the effect of computers on the individual and on society.

More computers were found in our male students' homes, and about 70 percent of our students reported that the primary computer users at home were males. The presence of a computer at home, in itself, may not encourage women to use it. Because of this gender gap in the use of home computers and the lack of a female computer-user role model at home, women may perceive that working with computers is not enjoyable or easy for females, and belongs to the "male domain."

The positive correlation between computer attitudes and experience revealed that students who knew more about the computer, used computers more, and had more access to home computers were also more interested in computers and had more confidence in working with them. As Wu and Morgan stated [48], computer

attitudes and the amount of computer use are reciprocally related: "Lack of exposure to computers may contribute to dislike or 'fear' of computers which may in turn ensure continued lack of exposure, such 'fear' is also likely to produce lack of use in the first place" [48, p. 226].

The other important outcome of this study was related to the parents' role in influencing participants' attitudes toward computers. Students in our sample reported that their parents, especially their fathers, tended to agree that men know more about computers, and have more ability to use them, or that the study of computers is more appropriate for males. The young women who perceived their parents' attitudes in this way had less interest and confidence in using computers. Previous research has also shown that parents hold different attitudes and beliefs about their sons' and their daughters' ability in different school subjects, and emphasized enrollment in science and mathematics courses more strongly for their sons than for their daughters. Parents' expectations and attitudes are correlated highly with students' decisions about taking courses and choosing career options [43, 49]. Yee and Eccles found that although boys and girls performed equally well in mathematics, their parents held different beliefs about their sons' and daughters' ability and effort, and attributed different causal explanations for mathematical achievement [50]. Both mothers and fathers attributed their sons' mathematical success more to talent and their daughters' success more to effort. "As an attribution to lack of ability is more debilitating to one's self-esteem and self-confidence, we might then agree that parents thus influence girls to develop lower estimations of their math ability" [50, p. 331].

The subjects also had different perceptions about the encouragement they received from their parents to become involved with computers. Male students agreed that their parents encouraged them to take computer courses and to learn more about computers; female students disagreed that they had received such encouragement. The Pearson correlations revealed more positive attitudes among students who perceived that their parents encouraged them to learn about computers. In view of the response of students, especially females, who indicated that their parents' attitudes were important in their choice of classes, one should expect such a positive relationship between parental encouragement and students' attitudes toward computers.

The posttest revealed that one semester of training and using computers in a structured environment could enhance both male and female students' attitudes toward computers, and could increase their frequency of use. By the end of the semester, students were more interested in working with computers and were more confident about their own ability to use them. The gender gaps were not completely eliminated, however: female students still had less positive attitudes toward computers than male students. The explanation for such a result is that the gender gap in working with computers is created and influenced by multiple factors; therefore no single solution will eliminate it. The results of this study support the argument that familiarity and knowledge increase both males' and

females' interests in computers, and reduce their anxiety and lack of confidence in dealing with them. The gender differences, however, cannot be attributed only to computer experience; parental attitudes and behavior also influence students' selection of courses and careers. Students use their parents as the major source of information and guidance for educational and occupational choices [50]; thus parents' stereotypic beliefs and expectations about their daughters' and sons' academic ability and performance may translate into negative attitudes among female students and may deter them from entering computer fields.

The females' negative attitudes were unrelated to their performance in the course; their final grades were much higher than those of male students. We have no explanation for such a finding. We can only speculate that females' perception of the usefulness and value of computers in their education and career, and their strong belief that women have as much ability as men in learning to use computers, encouraged them to put more effort into the course and obtain better grades.

The educational implications of this study are twofold. First, as we have demonstrated, training and use have a positive effect on women's attitudes toward computers. However, female students must acquire this training and experience before they reach college. Studies have shown that female students are discouraged from entering computer fields at an early stage of their education. Therefore curriculum changes must be made at the primary and high school levels, and computer use and programming skills must be integrated across the curriculum. School educators must ensure that all students have equal computer access and training, and must use unbiased software that appeals to girls as well as to boys. Teachers should not hesitate to require female students to work with computers, assign them to demonstrate programs in class, and encourage them to take a leadership role in their computer-using groups.

Second, parents' positive attitudes and encouragement appear to be important in motivating females to become involved with computers. A systematic and structured program, such as a workshop, is necessary to help parents understand their importance in encouraging their daughters to learn about computers, and to persuade parents, fathers in particular, to become supportive in their daughters' computer education programs. Parents must be made aware of their daughters' potential for high-paying computer-related jobs and of the importance of early parental encouragement in achieving this outcome. Otherwise, half of our population will be deprived of equal social and economic opportunity, and a valuable economic resource will be lost.

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