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Gender, Internet and computer attitudes and experiences

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Abstract

It is widely assumed that participation by females on the Internet is hampered by their attitudes towards computers, which in turn is reflective of their attitudes towards new technology. Research generally supports that females have less overall experience with computers and are more likely than males to have negative attitudes towards computers. Although limited, research on Internet experiences and attitudes has found parallel gender differences, with females reporting lower levels of experience and more negative attitudes. This paper explores whether Internet and computer experiences, skills and attitudes are related, using evidence from two studies of incoming college students, in 1989/90 and 1997. There were significant gender differences in many computer experiences and attitudes of incoming students in 1989/90. Males were more experienced with computers, more likely to have taken high school courses requiring computer use, and reported higher skill levels in applications such as programming, games and graphics than females. By 1997, incoming students were more experienced with using a computer than the earlier students. However, gender differences in computer experience and skill levels had diminished in some areas. The 1997 survey also assessed Internet experiences, skills, competence and comfort. Students had more exposure to computers than to the Internet. Males were more experienced and reported higher skill levels with the Internet than females, with the exception of e-mail. The overall competency and comfort level for students in 1997 was significantly higher for computers than for the Internet; 19% of the students did not feel competent and/or comfortable with the computer compared to 36% with the Internet, with females reporting higher levels of incompetence and discomfort for both. Competence and comfort levels with the Internet and computers were highly intercorrelated, and both predicted Internet skills and experiences.

Keywords: Gender; Internet; Computer attitudes; Computer experiences; Internet attitudes; Internet experiences; Computer competence; Internet competence; Computer comfort; Internet comfort

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We live in a time of rapid technological change. Throughout the 1980s and 1990s, a technological revolution has occurred, first in the wide-scale adoption of computers and then in the ongoing adoption of the Internet, heralding the Information Age. In the United States, ownership of computers has risen from 7% of households in 1983 to 44% of households in 1997, and 60% of households with children (Tapscott, 1998). Internet access in the 1980s was primarily limited to a select and small group of scientists, academics and hackers, and it is only in the last few years that Internet use has begun to penetrate the general population. Growth of Internet use has been exponential, doubling every 6 months. By May 1999, almost 101 million people, 37.4% of the total population in the United States have Internet access (NielsenNetRatings, 1999). These changes have altered everyday life in the workplace, schools, and homes. For example, the percentage of students who have used a computer in school has grown from 29% in 1984 to 72% in 1997, with the percent of children using a computer at home or school in 1997 rising to 82% (Tapscott). Internet access in public schools increased from 35% of schools in fall of 1994 to 89% of schools in fall 1998. (National Center for Educational Statistics [NCES], 1999).

Unfortunately, not all demographic groups have participated in the information revolution. Those who are poorer, less educated, from rural areas, and females consistently have been slower to use both computers and the Internet (Bikson & Panis, 1997; Tapscott, 1998). The gap between those with and without computer and/or Internet access has serious consequences. It is creating a new schism: a society of digital and information haves and have-nots. "The issue is not just access to...new (technology), but rather whether differences in availability of services, technology fluency, motivation, and opportunities to learn may lead to a two-tiered world of knowers and know-nots, doers and do-nots" (Tapscott, 1998, p. 256). Computer and Internet expertise has important educational and economic benefits. Educational institutions at all levels increasingly use both computers and the Internet for courses, research, and distance education, making computer and Internet access and skills critical for students. Individuals using computer-based communications have more accurate political information than peers without access do. A 1994 survey of technology found that 63% of adults in the USA who use computers and networks scored high on a current events quiz compared to 50% of similar peers without network access and 28% of peers who do not use computers (Times Mirror, 1994). Internet access provides information in a variety of areas. In the 1997 American Internet User Survey, 87% of Internet users said that the Internet provides them with more efficient access to information that they need daily and 77% said that being online helped them to be more productive on their jobs (FIND/SVP, 1997). Computer and Internet use at work has direct economic benefits. Analysis of the Current Population Surveys from 1984–1989 found those who use computers at work earn 10–15% more than comparable peers do (Krueger, 1993). A 1997 survey of Internet use among working women in the United States found Internet access at work was associated with higher pay, leveling salary differences associated with educational differences (Avon Products, 1997). The stratification between those with and without Internet access is creating a digital divide. "The rich are going to be

getting even richer in terms of information. The information-poor will become even more impoverished as government bodies, community organizations and corporations. . .displac(e) resources from their ordinary channels of communication onto the Internet'' (Katz, cited in Kornblum, 1997).

The current study has two parts. The first part of the study focuses on changes in computer experiences and skills among incoming college students from 1989/1990 to 1997, and whether gender differences found in the earlier period continue into the latter period. The second part of the study explores the relationship between computer and Internet attitudes, skills, and experiences, again examining gender differences, among incoming students in 1997.

Consistent with national trends in the United States (NCES, 1997; US Census Bureau, 1999), it is anticipated that both female and male students in 1997 will have more overall exposure to computers than students in 1989/1990. An earlier analysis of students in 1989 and 1990 found significant gender differences with males reporting greater experience and skills with computers than females (Morahan-Martin, Olinsky & Schumacher, 1992). However, gender differences in computer experiences have diminished considerably in national survey data (NCES; US Census Bureau, 1999). Greater computer experience has been associated with both greater skills and more favorable attitudes towards computers (Al-Khaldi & Al-Jabr, 1998; Carlson & Wright, 1993; Igbaria and Chakrabarti, 1990; Levine & Donitsa-Schmidt, 1998; Pope-Davis & Vispoel, 1993). Therefore, it is anticipated that gender differences in computer experiences found in 1989/1990 will diminish if not disappear in 1997.

The 1997 portion of the study also includes a comparison of computer and Internet experiences and behaviors. Widespread use of the Internet is more recent than widespread use of computers, and it is anticipated that students would report more experience with computers than with the Internet. Experience in turn is related to more favorable attitudes (Al-Khaldi & Al-Jabr, 1998; Carlson & Wright, 1993; Igbaria & Chakrabarti, 1990; Levine & Donitsa-Schmidt, 1998; Pope-Davis & Vispoel, 1993). Therefore, it is anticipated that students would report more favorable attitudes in terms of competency and comfort with computers than with the Internet.

Gender differences in comfort and competence with computers and the Internet as well as in Internet experiences were also examined. Although mixed, research generally has found that males have more favorable attitudes towards computers than females. For example, some studies have found females to be more likely to be computer phobic than males (Igbaria & Chakrabarti, 1990; Rosen & Maguire, 1990). Explanations for females being more likely to have negative attitudes towards computers have included sex role stereotypes, children's computer games, a male mystique surrounding computers, the hacker culture, and differences in socialization towards both technology and computers (Morahan-Martin, 1998). It is predicted that in this study, despite anticipated lessening of gender differences in computer experiences, female students would report lower levels of competence and comfort with computers than males in 1997.

Gender differences in Internet experiences and competency and comfort were examined as well. Males have dominated the Internet since its inception. Although

use of the Internet by females has increased dramatically in the last few years, males still use the Internet more than females in North America (Cyberdialogue, 1998; Graphics, Visualization, and Usability Center [GVU], 1998). To the extent that the Internet represents the latest technological frontier (i.e. Cyberspace), males being more likely to be earlier adapters of the Internet may be representative of stereotypic male fascination with and adoption of new technology, which has been confirmed in other studies (De Santis & Youniss, 1991; Focus on technology, 1997; McKenna, 1997). As the computers were cutting edge technology in the 1980s, the Internet represents cutting edge technology in the 1990s. Females being slower to adopt the Internet may be reflective of their being more likely to be technophobic than males (Weil & Rosen, 1995, 1997). Fear of technology increases resistance to adapting new technology (Ellen, Bearden & Sharma, 1991; Rosen & Weil, 1995). Therefore, it is predicted that males would report more experience and skills as well as more comfort and competency with the Internet than would women.

Finally, the relationships between computer and Internet experiences and attitudes of students in 1997 were examined. As the Internet is still primarily computer-based, experience, skills and attitudes towards computers logically should affect experience, skills and attitudes towards the Internet. The technical logistics of going online are a major obstacle to going online for both experienced Internet users and those who have never used the Internet. In a national opinion survey of non-Internet users, almost half (48%) said they had no idea how to use the Internet while 42% said the Internet was too complicated (Katz & Aspden, 1996). A follow-up study of those who stopped using the Internet found 18% discontinued use because of problems related to using the Internet such as "it was too hard" (Katz & Aspden, 1997). The current study hypothesized that competency and comfort with the computer would be significantly related to competency and comfort with the Internet. Further, it hypothesized that degree of both computer and Internet competency and comfort would be positively related to both Internet and computer experience.

1. Method

1.1. Participants

Surveys concerning computer and Internet use and attitudes were administered to incoming undergraduate college students. Students were asked to complete the surveys during summer orientation programs in 1989 and 1990 and again in 1997. The original survey was administered by the Institutional Technology Department in 1989 and in 1990 to assess the college's computer needs. This survey included questions concerning experience and skill level with different computer applications and software. The survey was voluntary and was completed by 619 students, which was 45.5% of the 1360 incoming first year students. In 1989, 161 of the incoming male students (41% of 393), and 157 of the incoming female students (51% of 310) completed the survey. In 1990, 165 of the incoming male students (43% of 386), and 136 of the incoming female students (50% of 271) completed the survey. In the analysis

of the data from the surveys for these 2 years, the analysis of variance procedure was run on the combined data with three variables of interest: gender, year and the interaction of gender by year. There was no significant interaction between gender and year and, in addition, the year of the survey was found to have no significant effect on any of the quantitative variables. Hence all results are reported for the combined data from the 1989 and 1990 surveys.

In 1997, the survey was again administered to incoming first year students at summer orientation. Since the Internet had become an important aspect of computer use, questions were added to address Internet and e-mail use and attitudes. A total of 225 incoming students completed the survey (36% of 619), including 136 incoming male students (34% of 397) and 89 (40% of 222) of the incoming female students. The average age of all students completing the survey in 1997 was 17.75 (S.D. = 0.51) years.

1.2. Measures

Participants in 1989 and 1990 completed a survey that included sections assessing demographics, general computer use, computer use in specific applications, skill level and amount of experience with various applications. In 1997, the survey included the same sections with questions added concerning Internet use and attitudes.

1.2.1. Computer and Internet use

The 1989/1990 survey assessed overall computer use with three yes–no questions: use in high school, use at home, and use in a course requiring the computer. These questions were asked again in 1997 along with three corresponding Internet use questions: use of the Internet and e-mail, participation in a course requiring Internet use, and interest in connecting to the campus network. Participants were also asked whether or not they owned their own computer. The later survey also assessed, for both the computer and the Internet, how long each had been used and for how many hours per week.

1.2.2. Use in specific applications

The section assessing depth of use contained 15 yes–no questions on both surveys. In 1989–90, the questions addressed computer use in various types of courses and for different applications including writing in different programming languages such as BASIC, COBOL, PASCAL, FORTRAN, and ASSEMBLY LANGUAGE. In the 1997 survey, only one question was included to assess whether the participants had used the computer to write computer programs. In 1997, the students were asked in this section whether they had used the computer to access e-mail, the Internet, or the WWW, and if they had used the computer to play games.

1.2.3. Skill level in specific applications

The section addressing skill level in various applications contained seven questions assessing skills in 1989/1990. Participants were asked to rate their skill (1 = poor or

none, 2 = fair, 3 = good, 4 = expert) in the following areas: typing skill, skill using DOS, programming skills, word processing skills, spreadsheets skills, general math skills and accounting skills. In 1997, the DOS skill question was dropped and three questions were added addressing skill using the Internet, using e-mail, and finding information online.

1.2.4. Experience level in various applications

Participants were also asked to rate the amount of experience they had in various applications (1 = little or none, 2 = some, 3 = more than average, 4 = a lot). In the 1989/1990 survey, the applications included using the following: IBM PC or compatible, the Apple computer, a Macintosh, word processing, spreadsheets, accounting programs, computer programs, and playing computer games. In the 1997 survey, the last five questions were retained and the first three were replaced with the following two applications: using the Internet and sending and receiving e-mail.

1.2.5. Competency and comfort with computers and the Internet

In the 1997 survey, four Likert type questions were added, two which assessed degree of competency and comfort towards computers and two which assessed degree of competency and comfort towards the Internet. The responses to the two computer questions: "I am comfortable using a computer" and "I feel competent in my ability to use a computer" were later combined to create a new quantitative variable, Computer Comfort/Competency. Similarly, the responses to the two Internet questions: "I feel comfortable using the Internet" and "I feel competent in my ability to use the Internet" were later combined to create a second quantitative variable, Internet Comfort/Competency.

1.3. Procedures

In both studies, in order to assess gender differences, crosstabs and the chi-square (χ^2) statistics were used for dichotomous (yes/no) variables, *t*-tests were used for quantitative variables, and analysis of variance (ANOVA) was used for Likert scale variables. Pearson correlation coefficients were used to compare the two quantitative variables Computer Comfort/Competency and Internet Comfort/Competency. A multivariate general linear model was used to compare computer and Internet experience and skills by computer and Internet comfort and competency.

2. Results

2.1. Comparison of students' computer use and experience in 1989/1990 and 1997

In 1989/1990, over 90% of all students had used the computer in high school, over 80% had taken a course which required the use of a computer, and approximately 50% had used a computer at home with no significant gender differences on any of these questions. As can be seen in Table 1, there were dramatic increases in computer

Table 1
Changes in college freshman computer use over time[a]

Have used a computer	1989/90 ($n=619$; %)	1997 ($n=225$; %)	Test statistic (df = 1; χ^2)
In high school	90	99.6	22.1***
In required course	80	93.3	21.4***
At home	50	87	94***
In a science course	15.86	47.6	90.3***
To write graphics or games	23.42	21.8	0.244
To write BASIC programs	53.8	NA	
To write PASCAL programs	10.5	NA	
To write computer programs	NA	27.6	

[a] df, degrees of freedom; NA, question not asked. *Significant at 0.05, **Significant at 0.01, ***Significant at 0.001.

experience in 1997, with 99.6% of all students having used a computer in high school, 93% having used the computer in a required course, and 87% having used the computer at home. Again, there were no gender differences with these questions. From Table 2, it can be seen that although the students had used the computers much more in 1997, they did not report increases in all skill and experiences. Although a significant increase in skill level in keyboarding and experience in playing computer games was reported, there was actually a decrease in the reported levels of skill in programming and experience in writing computer programs.

Gender differences, as reported in Table 3, did not occur in use of a computer in high school, at home or in a required course in either study. However, in 1989/90, males were more likely (18.71%) than females (12.59%) to have used a computer in a science course. This difference was not significant in 1997. As far as use in various applications, in 1989/90 males were more likely to write BASIC programs and to write PASCAL programs, and in 1997 this gender difference remained with more males (34%) reporting using a computer to write computer programs than did females (18%), but there was no longer significant differences in writing graphics/games.

Reported skill and experience levels by gender over time are reported in Table 4. In 1989/1990, females reported greater level of typing skills than males, and males

Table 2
Changes in college freshman computing skill and experience over time[a]

Skill or experience	1989/90 Mean ($n=619$)	1997 Mean ($n=225$)	t-Test statistic (df = 842)
Skill level in typing or keyboarding	2.506	2.75	−4.95***
Skill level in programming	1.84	1.7	2.27*
Experience using computer programs	1.857	1.50	4.98***
Experience playing computer games	2.64	2.91	−3.98***

[a] df = degrees of freedom. Skill level scale: 1 = poor/none; 2 = fair; 3 = good; 4 = expert. Experience scale: 1 = little/none; 2 = some; 3 = more than average; 4 = a lot. *Significant at 0.05, **Significant at 0.01, ***Significant at 0.001.

Table 3
Gender differences in college freshmen computer use over time[a]

Used a computer	1989/90 Male ($n=326$; %)	1989/90 Female ($n=293$; %)	Test Statistic (df = 1; χ^2)	1997 Male ($n=136$; %)	97 Female ($n=89$; %)	Test Statistic (df = 1; χ^2)
In high school	91.1	90.8	0.016	100	98.8	0.215
In required course	80.1	82.3	2.05	91.9	95.5	0.300
At home	50.3	44.5	0.483	89.7	83.1	0.151
In a science course	18.7	12.6	4.36*	49.3	44.9	0.526
To write BASIC programs	59.8	47.6	9.26**	NA	NA	
To write PASCAL programs	14.1	6.5	9.63**	NA	NA	
To write computer programs	NA	NA		33.8	18	0.6.77**
To write graphics or games	26.7	19.7	4.18*	22.8	20.2	0.648

[a] df, degrees of freedom; NA, question not asked. *Significant at 0.05. **Significant at 0.01. ***Significant at 0.001.

Table 4
Gender differences in college freshmen computer skills and experience over time[a]

Skill or experience level	1989/90 male ($n=326$)	1989/90 female ($n=293$)	Test statistic (df = 1617; f)	1997 male ($n=136$)	1997 female ($n=89$)	Test statistic (df = 1223; F)
Skill in typing or keyboarding	2.373	2.654	24.4**	2.75	2.75	0.001
Skill in programming	1.913	1.759	5.62*	1.74	1.64	0.941
Experience writing computer programs	1.941	1.765	5.22*	1.63	1.31	8.28**
Experience playing computer games	2.858	2.402	34.6**	3.02	2.75	4.95*

[a] df, degrees of freedom. Skill level scale: 1 = poor/none; 2 = fair; 3 = good, 4 = expert. Experience scale: 1 = little/none; 2 = some; 3 = more than average; 4 = a lot. *Significant at 0.05. **Significant at 0.01. ***Significant at 0.001.

reported greater programming skill than females. Neither of these questions yielded significant gender differences in 1997. In assessing their experience with the various applications, in the earlier survey males reported greater experience in writing computer programs and in playing computer games. These differences remained in 1997 with males again reporting more experience than females in writing computer programs and in playing games. In addition to the reported gender differences for the two studies, in 1997, more males (72%) than females (60%) reported owning a computer ($\chi^2 = 3.81$, $P = 0.05$); this question had not been asked previously.

Despite these differences, there were no differences reported in 1997 between males and females in how long they had been using a computer. However, males reporting using the computer more hours weekly ($M = 9.27$, S.D. = 13.23) than females ($M = 5.99$, S.D. = 7.30, $t = 2.27$, $P = 0.024$).

2.2. Comparison of computer versus Internet experience and attitudes in 1997

Students generally had more experience and skills with computers than with the Internet in 1997. All students had used a computer while 86% had used the Internet, WWW, or e-mail. They were also more likely to have taken a high school course requiring the use of the computer (93.4%) than one requiring use of the Internet (29.6%). On a weekly basis, students used the computer more hours ($M = 9.49$, S.D. = 12.97) than they used the Internet (M = 6.14, S.D. = 9.67, $t = 5.76$, $P < 0.000$).

Students scored higher on Computer Comfort/Competency ($M = 6.31$, S.D. = 1.32) than on Internet Comfort/Competency ($M = 5.75$, S.D. = 1.75, $t = 6.15$, $P < 0.000$). In order to form a dichotomous variable, Computer Competence, assessing computer competency, students were defined as either computer competent or not based on their scores on the Computer Comfort/Competency variable. Those who agreed or strongly agreed with both the computer comfort and the computer confidence questions were called computer competent (CC) all others were called computer incompetent (CI). The same procedure was used to assess Internet competence (IC) and Internet incompetence (II) by defining the dichotomous variable Internet competence. More students were computer competent (81%) than Internet competent (64%) ($\chi^2 = 33.37$, $P < 0.000$).

2.3. Comparison of gender differences in Internet skills and attitudes in 1997

Tables 5 and 6 present the gender differences found in Internet use and experience in 1997. Males were more experienced with the Internet than were females. More males (89.6%) than females (79.4 %) had used the Internet at all. Males also used the Internet more hours weekly ($M = 7.43$, S.D. = 11.2) than females ($M = 3.14$, S.D. = 3.19, $t = 3.48$, $P = 0.001$). However, there were no gender differences in how long they had been using the Internet ($M = 19.1$ months, S.D. = 15.42) or in having taken a course in high school that required the use of the Internet (males = 32%, females = 26.4%). Males did report more skill than females in both using the Internet, and finding information online. Males also reported more experience in using the Internet and the Web than females. There were no gender differences in having ever having used e-mail (males = 71.3%, females = 66.3%), or in reported skill levels using e-mail, or amount of experience using e-mail.

Table 5
Gender differences in college freshman Internet use 1997

Have used a computer	Male ($n = 136$; %)	Female ($n = 89$; %)	Test statistic (df = 1; χ^2)[a]
To access the Internet	89	76.4	6.32*
To access e-mail	71.3	66.3	0.424
To access the WWW	72.8	53.9	8.45**
In a course requiring the Internet	32.1	26.4	0.37

[a] df, degrees of freedom. *Significant at 0.05. **Significant at 0.01. ***Significant at 0.001.

Table 6
Gender differences in college freshmen Internet skills and experience in 1997[a]

Skill or experience level	Male ($n=136$)	Female ($n=89$)	Test statistic (df = 1223; F)
Skill in Internet use	2.61	2.22	9.3**
Skill in using e-mail	2.43	2.25	1.51
Skill using information online	2.53	2.19	6.49*
Experience using the Internet and WWW	2.49	2.10	12.17**
Experience using e-mail	2.3	2.09	1.99

[a] df, degrees of freedom. Skill level scale: 1 = poor/none; 2 = fair; 3 = good; 4 = expert. Experience scale: 1 = little/none; 2 = some; 3 = more than average; 4 = a lot. *Significant at 0.05. **Significant at 0.01. ***Significant at 0.001.

In addition to the gender differences in skills and experience, gender differences were found in reported levels of computer comfort and confidence, with males scoring higher on the Computer Comfort/Competency variable ($M_m = 6.5$, S.D. = 1.24; $M_f = 6.06$, S.D. = 1.39; $t = 2.465$, $P = 0.014$). Significant gender differences were also reported in levels of Internet comfort and confidence, with males scoring higher on the Internet Comfort/Competency variable ($M_m = 6.04$, S.D. = 1.58; $M_f = 5.32$, S.D. = 1.91; $t = 2.92$, $P = 0.004$).

2.4. Relationship between computer and Internet experiences and attitudes, 1997

A Pearson Correlation Coefficient was used to assess the relationship between Computer Comfort/Competency and Internet Comfort/Competency. The results were significant ($r = 0.642$, $P < 0.000$).

In order to determine the relationship between computer and Internet experiences and skills and both computer and Internet comfort/competency, the General Linear Model (GLM) procedure was used. All skills and experience questions were used as dependent variables, first with the independent variable Computer Competence and then with the independent variable Internet Competence.

For Computer Competence, the overall test was significant ($F[14,204] = 7.25$, $P < 0.000$), with all nine computer related and all five Internet related skills and experiences significant with $P \leqslant 0.013$ (Table 7). For Internet Competence, the overall test was significant ($F[14,204] = 13.916$, $P < 0.000$) with all five Internet related skills and experiences and seven of the nine computer related skills and experiences significant with $P \leqslant 0.034$ (Table 8). In all cases, those who were more competent reported greater levels of skills and experience.

3. Discussion

The results obtained confirmed most hypotheses. The greater reported experience with computers in 1997 compared to 1989/1990 is consistent with national data which indicates increasing computer usage among youth in schools and at home (NCES, 1997; Tapscott, 1998; US Census Bureau, 1999). Virtually all students in the

Table 7
Means, standard deviations, *F* values and significance levels of computer and Internet skills by computer competence[a]

Individual items	Group	Mean	S.D.	*F*	*P*
Skill level in typing or keyboarding	CC	2.85	0.55	34.327	0.000
	CI	2.27	0.67		
Skill level in programming	CC	1.79	0.83	9.747	0.002
	CI	1.37	0.54		
Skill level in wordprocessing	CC	3.11	0.64	56.121	0.000
	CI	2.27	0.71		
Skill level in spreadsheets	CC	2.50	0.92	33.662	0.000
	CI	1.61	0.70		
Skill level in Internet use	CC	2.64	0.91	40.460	0.000
	CI	1.68	0.69		
Skill level in using e-mail	CC	2.54	1.05	39.782	0.000
	CI	1.46	0.60		
Skill level using information online	CC	2.58	0.95	42.700	0.000
	CI	1.56	0.63		
Experience using the Internet & WWW	CC	2.47	1.02	35.589	0.000
	CI	1.49	0.52		
Experience using e-mail	CC	2.36	1.08	26.984	0.000
	CI	1.44	0.71		
Experience using spreadsheets	CC	2.31	1.00	23.394	0.000
	CI	1.51	0.71		
Experience using wordprocessing	CC	3.28	0.76	46.065	0.000
	CI	2.37	0.86		
Experience using accounting programs	CC	1.94	0.96	6.324	0.013
	CI	1.54	0.84		
Experience using computer programs	CC	1.60	0.89	11.163	0.001
	CI	1.12	0.33		
Experience playing computer games	CC	3.02	0.88	12.106	0.001
	CI	2.49	0.87		

[a] CC, computer competent ($n = 178$); CI, computer incompetent ($n = 41$). Skill level scale: 1 = poor/none; 2 = fair; 3 = good; 4 = expert. Experience scale: 1 = little/none, 2 = some, 3 = more than average; 4 = a lot.

1997 study had used a computer in high school (99.6, up from 90% in 1989/90), and almost all had used a computer in a required course (93 compared to 80% earlier). The increase in home use of the computer was sharp, from 50 to 87%. In both 1989/1990 and 1997, the students in this study had more computer experience both at home and school than those in national studies, which may be a function of the socioeconomic status of students in the current study.

As anticipated, there were fewer significant gender differences in computer experience and skills from 1989/1990 to 1997. However, males continued to report more experience in programming and playing computer games. Also, more males (72%) than females (59.6%) reported owning their own computer in 1997. The continued domination of males in computer ownership, programming, and game playing has consistently been found in other studies (Griffiths, 1993; Simmons

Table 8
Means, standard deviations, F values and significance levels of computer and Internet skills by online competence[a]

Individual items	Group	Mean	S.D.	F	P
Skill level in typing or keyboarding	IC	2.83	0.62	7.773	0.006
	II	2.59	0.59		
Skill level in programming	IC	1.82	0.72	7.309	0.007
	II	1.51	0.83		
Skill level in wordprocessing	IC	3.08	0.71	10.979	0.001
	II	2.74	0.73		
Skill level in spreadsheets	IC	2.43	0.97	4.549	0.034
	II	2.14	0.91		
Skill level in Internet use	IC	2.91	0.74	171.286	0.000
	II	1.62	0.63		
Skill level in using e-mail	IC	2.78	0.96	102.308	0.000
	II	1.53	0.70		
Skill level using information online	IC	2.83	0.83	135.230	0.000
	II	1.56	0.66		
Experience using the Internet & WWW	IC	2.72	0.92	120.840	0.000
	II	1.46	0.57		
Experience using e-mail	IC	2.60	1.06	72.508	0.000
	II	1.46	0.68		
Experience using spreadsheets	IC	2.23	1.04	2.466	0.118
	II	2.01	0.92		
Experience using wordprocessing	IC	3.21	0.83	5.558	0.019
	II	2.92	0.88		
Experience using accounting programs	IC	1.89	0.98	0.293	0.589
	II	1.82	0.91		
Experience using computer programs	IC	1.67	0.93	15.384	0.000
	II	1.22	0.53		
Experience playing computer games	IC	3.01	0.91	5.503	0.020
	II	2.72	0.87		

[a] IC, Internet competent ($n = 141$); II, Internet incompetent ($n = 78$). Skill level scale: 1 = poor/none; 2 = fair; 3 = good; 4 = expert. Experience scale: 1 = little/none; 2 = some; 3 = more than average; 4 = a lot.

Market Research Bureau, 1994; Tapscott, 1998; US Census Bureau, 1999; Weil & Rosen, 1995). It has been argued that computer games for children, which are largely marketed to boys, are the gateway to the computer (Morahan-Martin, 1998, for a fuller discussion). Only 23–33% of computer games are sold for girls (DeWitt, 1997). The most popular computer games for children reflect themes of action, adventure, violence, sports, and competition (Griffiths, 1993; Tapscott, 1998), and have characters reflecting exaggerated gender stereotypes of macho, dominant males and submissive or sexual females (Gailey, 1993); both of which may explain why they appeal more to boys than girls. Those who play computer games learn the programming skills necessary for survival in these games and at the same time they learn to treat the computer as a toy (Gailey, 1993). Males' greater experience as boys with computer games and programming enhances their technological sophistication

with computers and may explain why males are generally found to feel, as in this study, more comfortable and competent with computers than females (Busch, 1995).

A significant minority of students in 1997 reported lack of comfort and competency with both the computer and the Internet. As anticipated, the overall competency and comfort level for students was significantly higher for computers than for the Internet; 19% of students were not computer competent compared to 36% who were not Internet competent. This is hardly surprising as the Internet is a newer technology to students than the computer, and students have less experience using the Internet than using the computer. Still, about one-fifth of students reported that they were uncomfortable and/or incompetent with the computer and the percentage is almost double for the Internet. It is possible that the 19% who are uncomfortable and/or feel incompetent with the computer in this study represent a subgroup in the population who are actively uncomfortable not only with computers, but also with new technology. Weil and Rosen (1997) refer to this group as technological resisters, and characterize them as individuals who avoid technology because they are intimidated and embarrassed by their incompetence with technology. The higher percentage of individuals who report discomfort and incompetence with the Internet may be reflective not only of this being a newer technology with which they have less experience, but also of the technical logistics of going online. Fifty-nine percent of adults reported that they were hesitant, resistant or frustrated about communication technology in a 1997 study conducted by MCI One (cited in Weil & Rosen, 1997). This percentage is higher than in the current study, which may be explained by the age differences. Teens and young adults generally have more favorable attitudes towards technology than older adults (McKenna, 1997; Tapscott, 1998).

As predicted, females reported less competency and comfort for both computers and the Internet than males and less Internet experience. This is consistent with earlier research which has generally found that compared to males, females are less comfortable and confident with the computer (Busch, 1995) and the Internet (Morahan-Martin & Schumacher, 1997). Several factors may contribute to males feeling more comfortable and competent with computers and the Internet. Although the percentage of males and females with any computer experience has leveled, males, from childhood on, have more experience with computers than females, especially with games and programming, which may lead to males' greater overall levels of competence and comfort with computers. Computer ownership also may play a role. In this study as in others (Simmons Market Research Bureau, 1994; US Census Bureau, 1999), males were more likely to own a computer than females. Computer ownership in turn is associated with more favorable computer attitudes and greater computer experience (Nichols, 1992). Additionally, males having more Internet experience, which was found in this study and has been consistently found in survey data (Cyberdialogue, 1998; FIND/SVP, 1997; GVU, 1997), facilitates their having greater comfort and confidence online than females. Negative attitudes towards new technology, which, as discussed earlier, is more common in females than males may also play a role in females being less comfortable and competent with computers and the Internet than males. Weil and Rosen (1997) found technological resisters are more likely to be females than males. This may be particularly

pertinent with the Internet which currently represents cutting edge technology. However, with time, experience, and simplified Internet access, one would expect that not only will overall levels of comfort and competence with the Internet increase, but also that gender differences will diminish.

Competence and comfort levels with computers and the Internet were highly intercorrelated, and both predicted both computer and Internet experience. These results were anticipated because the Internet is computer based, and one would expect attitudes and behaviors to the computer would carry over to the Internet; however, to the authors' knowledge, no other study has directly confirmed this relationship. The HomeNet study, however, gives support for the difficulties of being online (Kraut, Scherlis, Mukapadhyay, Manning & Kiesler, 1996). This study monitored 48 families' Internet use in return for their being given free use of a computer as well as free Internet access, training and support. It found the technical logistics of going online were a major obstacle for both those with and without prior computer experience. They encountered problems such as "bad telephone lines and busy signals, passwords forgotten, misunderstood user interfaces, depressed shift-lock keys on keyboards, erased login scripts, and buggy software" (p. 57), which are familiar to experienced Internet users. However, "(m)any participants lacked clear models of how components of the overall system operated and could not diagnose problems. Some participants blamed themselves for problems caused by software bugs or overtaxed servers" (p. 57). Controlling for demographic differences, the study found that those with more pre-trial computer experience and males used the Internet more than others.

4. Conclusions

In the Information Age, computer and Internet skills are becoming increasingly important, and those without these skills are at a disadvantage economically and educationally. The current study examined changes in computer experiences among incoming college students from 1989/1990 to 1997. As predicted, students in 1997 had more computer experience than earlier students, and gender differences had diminished. However, in both years, males were more experienced than females with computer programming and games, and, in 1997, males were more likely to own a computer than females. Computer ownership as well as greater experience with programming and games may all enhance the technical sophistication of males with computers and account for the greater degree of competency and comfort with both the Internet and computers found among male students compared with female students in 1997 in the second part of the study. This part of the study found that a significant minority of students reported lack of competency and comfort with computers (19%) and the Internet (36%). Males spent more time online than females. Competency and comfort with computers and the Internet were highly intercorrelated and both predicted both computer and Internet experience.

This study raises both hope and concern. The comparison of students over an 8 year period from 1989 to 1997 highlights that with increasing overall computer use,

gender differences in computer experiences have diminished. However, some gender differences in computer experiences continue. Further, a substantial percent of students in 1997 were not comfortable and/or competent with computers or the Internet, with female students reporting greater discomfort and incompetence than male students. In turn, these negative attitudes hamper computer and Internet experience and skills. Those who continue to have these negative attitudes may find their educational and economic prospects limited.

This study is limited by the select population used, but it raises some important concerns. Future study is recommended with more diverse populations. For example, cross-sectional studies could compare generational and demographic differences while longitudinal studies could follow a cohort group over time. The role of early socialization to computers and technology and its impact on later experiences and attitudes may help explain some gender differences found in this and other studies and warrants further study as well. Finally, programs to enhance computer and Internet competency are needed.

References

Al-Khaldi, M., & Al-Jabr, I. (1998). The relationship of attitudes to computer utilization: new evidence from a developing nation. *Computers in Human Behavior, 9*, 23–42.

Avon Products (1997, May) (1997). *Technology: the "Great Equalizer" for working women (Executive Summary)*. NY: Avon.

Bikson, T., & Panis, C. (1997). Computers and connectivity: current trends. In S. Kiesler, *Culture of the Internet* (pp. 407–430). Mahwaw, NJ: Lawrence Erlbaum.

Busch, T. (1995). Gender differences in self-efficacy and attitudes towards computers. *Journal of Educational Computing Research, 12*, 147–158.

Carlson, R., & Wright, D. (1993). Computer anxiety and communication apprehension: relationship and introductory college course effects. *Journal of Educational Computing Research, 9*, 329–338.

Cyberdialogue, (1998, January 28). American Internet User Survey. [Online]. Available: http://www.cyberdialogue.com.fram.html.

De Santis, J., & Youniss, J. (1991, October). Family contributions to adolescents' attitudes toward new technology. *Journal of Adolescent Research, 6*, 410–422.

DeWitt, K. (1997, June 23). Girl games on computers, where shoot'em up simply won't do. (p. D3.) New York Times.

Ellen, P., Bearden, W., & Sharma, S. (1991). Resistance to technological innovations: an examination of the role of self-efficacy and performance satisfaction. *Journal of the Academy of Marketing Science, 19*, 297–307.

FIND/SVP (1997). The 1997 American Internet User Survey. [Online]. Available: http://etrg.finsvp.com/findf/html.

Focus on technology: teenagers and technology (1997, April 28). Newsweek, 86.

Gailey, C. (1993). Mediated messages: gender, class and cosmos in home video games. *Journal of Popular Culture, 27*, 81–97.

Graphics, Visualization, and Usability Center [GVU] (1988). GVU's WWW User Surveys. Atlanta, GA: George Tech Research Corporation. [Online]. Available: http://www.gatech.edu/user-surveys/survey-1997-10.

Griffiths, M. (1993, September). Are computer games bad for children? *The Psychologist*, 401–407.

Igbaria, M., & Chakrabarti, A. (1990). Computer anxiety and attitudes towards microcomputer use. *Behavior and Information Technology, 9*, 229–241.

Katz, J., Aspden, P. (1996, October). Motivations for and barriers to Internet usage: results of a national public opinion survey. A paper presented at the 24th Telecommunications Policy Research Conference, Solomons, MD. [Online]. Available: http://www.markle,org/J96329pd3.html#Users.

Katz, J., & Aspden, P. (1997). Internet dropouts: the invisible group. NY: Markle Foundation. [Online]. Available: http://www.markle,org/J96329pd8.html.

Kornblum, J. (1997, March 14). Society's digital divide. C/netnews.com. [Online]. Available: http://www.news.com/News/Item/0,4,8834,00.html.

Kraut, R., Scherlis, W., Mukapadhyay, T., Manning, J., & Kiesler, S. (1996). The HomeNet field trial of residential Internet services. *Communications of the ACM, 39*, 55–63.

Krueger, A. (1993). Why computers have changed the wage structure: evidence from microdata, 1984–1989. *Quarterly Journal of Economics, 108*(1), 33–61.

Levine, T., & Donitsa-Schmidt, S. (1998). Computer use, confidence, attitudes, and knowledge: a causal analysis. *Computers in Human Behavior, 9*, 125–146.

McKenna, P. (1997, September 10). Dell identifies new generation without age and gender separation. Newsbites News Network. [Online]. Available: http://www.newsbytes.com.

Morahan-Martin, J. (1998). Males, Females, and the Internet. In J. Gackenback, *Psychology and the Internet: intrapersonal, interpersonal, and transpersonal applications* (pp. 169–197). San Diego: Academic Press.

Morahan-Martin, J., & Schumacher, P. (1997, August). Gender differences in Internet usage, behaviors, and attitudes among undergraduates. In G. Salvendy, *HCI international '97: Proceedings of the 7th International Conference on Human-Computer Interaction* (pp. 122). Amsterdam: Elsevier Science.

Morahan-Martin, J., Olinsky, A., & Schumacher, P. (1992). Gender differences in computer experience, skills, and attitudes among incoming college students. *Collegiate Microcomputer, 10*, 1–8.

National Center for Educational Statistics [NCES] (1999, June 1999). Condition of Education. [Online]. Available:http://www.nces.ed.gov/pubsinfo.asp?pubid = 199902.

National Center for Educational Statistics [NCES] (1997). *Digest of Educational Statistics*. Washington D.C: US Department of Education.

Nichols, L. (1992). The influence of student computer ownership and in-home use on achievement in an elementary school computer programming curriculum. *Journal of Educational Computing Research, 8*, 407–421.

NielsenNetRatings (1999, June 28). How many Online? [Online]. Available: http://www.nua.ie/surveys/how_many_online/n_america.html.

Pope-Davis, D., & Vispoel, W. (1993). How instruction influences attitudes of college men and women towards computers. *Computers in Human Behavior, 9*, 83–93.

Rosen, L., & Maguire, P. (1990). Myths and realities of computerphobia: a meta-analysis. *Anxiety Research, 3*, 167–179.

Rosen, L., & Weil, M. (1995). Adult and teenage use of consumer, business and entertainment technology: potholes on the information superhighway? *Journal of Consumer Affairs, 29*, 55–84.

Simmons Market Research Bureau (1994). *1994 Study of media and markets*. NY: Simmons.

Tapscott, D. (1998). *Growing up digital: the rise of the Net generation*. New York: McGraw-Hill.

Times Mirror (1994). *Technology in the American household*. Los Angeles: Times Mirror.

US Census Bureau (1999, June 28). Computer use in the United States. [Online] Available: http://www.census.gov/population/www/socdemo/computer.html.

Weil, M., & Rosen, L. (1995). The psychological impact of technology from a global perspective: a study of technological sophistication and technophobia. *Computers in Human Behavior, 11*, 95–133.

Weil, M., & Rosen, L. (1997). *Technostress: Coping with technology @ work, @ home, @ play*. NY: Wiley.