Bibliography on Gender and Technology in Education

Compiled and Annotated by Jo Sanders, 2005

This bibliography was compiled for "Gender and Technology: A Research Review," 2005. You can download the paper from http://www.josanders.com/resources.html#pdf. The bibliography presented here is searchable by keyword, author, or title. Entries are annotated when I was able to obtain and review them. The keywords I used are:

Access
Adults
Advanced Placement
Age
Aggression
Applications
Attitudes and expectations
Barriers
Career factors
Classroom interactions
Context (social)
Counselors
Critical mass
Cross-cultural
Culture (of computing)
Curriculum
Departmental change
Distance education
Early work
Elementary/primary
Enrollments
Experience
Extracurricular programs
Games
Graphics
Interventions
Language and terminology
Learning styles
Males
Mathematics
Media
Methodology
Middle school
Middle school
Outreach
Outside U.S.
Parents and home
Pedagogy
Peers and friends
Physical safety
Pipeline
Policy
Postsecondary/tertiary
Preschool
Programming
Race, ethnicity, or SES
Recruitment
Research review
Retention
Role models and mentors
School programs
Secondary/high school
Single-sex environment
Software
Statistics
Stereotype threat
Stereotypes and bias
Support groups
Teacher education
Teachers and faculty
Telecommunications
Use patterns

From Barbie to Mortal Kombat: Gender and Computer Games. Eds. Justine Cassell and Henry Jenkins. Cambridge, MA: The MIT Press, 1998.

Keywords: Games, Stereotypes and bias, Software
Edited book about children's software, particularly "girl games." Chapters explore how stereotyped assumptions about gender, games and technology shape the design, development, and marketing of games.

Abbate, Janet. "How Did You First Get into Computing?" IEEE Annals of the History of Computing 25.4 (2003): 78-82.

Could not obtain: not reviewed.

---. "Women and Gender in the History of Computing." IEEE Annals of the History of Computing 25.4 (2003): 4-8.

Could not obtain: not reviewed.

Abler, R.M., and W.E. Sedlacek. "Computer Orientation by Holland Type and Sex." Career Development Quarterly 37 (1989): 163-69.

Could not obtain: not reviewed.

Acker, Sandra, and Keith Oatley. "Gender Issues in Education for Science and Technology: Current Situation and Prospects for Change." Canadian Journal of Education 18.3 (1993): 255-72.

Keywords: Career factors, Research review, Stereotypes and bias, Culture, Classroom interactions, Single-sex environment, Postsecondary learning & achievement, Barriers, Interventions, Teacher education

Paper reviews possible explanations for women's under-representation in science and technology (social-psychological approaches, school influences, stereotyping, and others) and recommends ways to achieve change. Excellent article.

Adler, M. "Gender Equity and Computer Technology." Equity Coalition 5 (1999): 9-13.

Could not obtain: not reviewed.

Agosto, Denise E. "Using Gender Schema Theory to Examine Gender Equity in Computing: A Preliminary Study." Journal of Women and Minorities in Science and Engineering 10.1 (2004): 37-53.

Keywords: Telecommunications, Culture, Secondary/high school

Eleven 14- and 15-year old girls were given the Bem sex-role inventory to determine if they scored feminine-high or masculine-high. The groups used different criteria to evaluate web sites, with the feminine-high girls considered graphic and multimedia design and the masculine-high girls considered subject content. Canada: women were Elementary learning & achievement25% of CS grads 2001.

Aman, James R. "Gender and Attitude toward Computers." In Search of Gender-Free Paradigms for Computer Science Education. Ed. C. Dianne & Murchie-Beyma Martin, Eric. Eugene, OR: International Society for Technology in Education, 1992. 33-46.

Keywords: Attitudes and expectations, Use patterns

Study in Catholic girls' high schools: frequent computer use leads to positive computer attitudes.

Ambrose, S. et al. "No Universal Constants: Journeys of Women in Engineering and Computer Science." Journal of Engineering Education 87.4 (1998): 363-68.

Could not obtain: not reviewed.

American Association for the Advancement of Science. Preparing Women and Minorities for the It Workforce: The Role of Nontraditional Educational Pathways, 2005.

Keywords: Career factors, Adults

This is a study of how "nontraditional" students (not aged 18-22 white kids) manage, or don't manage, to enter IT educational programs and occupations.

American Association of University Women Educational Foundation. Gender Gaps: Where Schools Still Fail Our Children. Washington D.C.: Author, 1998.

Keywords: Experience, Culture, Stereotypes and bias, Software, Career factors, Enrollments, Advanced Placement

Brief review of research on keyword topics, including girls' under-representation in AP courses.

American Association of University Women Educational Foundation Commission on Technology, Gender, and Teacher Education. Tech-Savvy: Educating Girls in the New Computer Age. Author, 2000.

Keywords: Culture, Programming, Curriculum, Teacher education, Enrollments, Use patterns, Applications, Telecommunications

An examination of gender in technology from girls' point of view. The shift in viewpoint emphasizes that using male computer behavior as the norm is unfair to girls and prevents solutions to the computer gender gap.

American Association of University Women Educational Foundation Commission on Technology, Gender, and Teacher Education,. Under the Microscope: A Decade of Gender Equity Projects in the Sciences. Washington D.C.: Author, 2004.

Keywords: Single-sex environment, Career factors, Programming, Applications, Middle school, Secondary/high school, School programs, Extracurricular programs, Attitudes and expectations

AAUW surveyed gender-related projects funded by the AAUW Educational Foundation and the National Science Foundation. 57% of technology projects were for girls only, targeted middle-school students, were extracurricular, and focused on affect (as opposed to academics).

Anderson, Ronald E., Wayne W. Welch, and Linda J. Harris. Computer Inequities in Opportunities for Computer Literacy. Minneapolis: University of Minnesota.

Keywords: Programming, Race, ethnicity, or low SES, Access

Programming enrollment remains primarily male. Access is a problem. Low-income, female, and rural students are disadvantaged in terms of school computers.

Apple, M. "Is the New Technology Part of the Solution or Part of the Problem in Education?" Technological Literacy and the Curriculum. Ed. J.M. Beynon, 1992.
Could not obtain: not reviewed.

Arch, Elizabeth C. "The Baldwin Effect: A Basis for Sex Differences in Attitudes toward Technology and Science." American Educational Research Association, 1995.
Keywords: Attitudes and expectations, Curriculum
Project designed to improve girls' attitudes towards computers and science using multimedia.

Arch, Elizabeth C., and David E. Cummins. "Structured and Unstructured Exposure to Computers: Sex Differences in Attitude and Use among College Students." Sex Roles: A Journal of Research 20.5/6 (1989): 245-54.
Keywords: Experience, Curriculum, Postsecondary/tertiary
In an experiment with 362 first-year college students, students were randomly assigned to an introductory writing course either with word processing taught as part of the course ("structured condition") or with computers and instruction readily available at the student's initiative ("unstructured condition"). Females in the structured condition went from lowest computer use prior to the course to the highest among the four groups (M/F, structured/unstructured), and scored significantly higher than females in the unstructured condition also on attitude towards computers and perceived skill level, all on self-ratings. For females, prior computer use was correlated to subsequent use; not true of males.

Arenz, Bernard W., and Millheon J. Lee. "Gender Differences in the Attitude, Interest and Participation of Secondary Students in Computer Use." American Educational Research Association. Boston, 1990.
Keywords: High school learning & achievement, Middle school learning & achievement, Role models and mentors, Attitudes and expectations, Use patterns
Gender differences in several studies were found in role models, attitudes, interest, and computer use, which may contribute to a continuing stereotype of computing as a male domain. (abstract only)

Armstrong-Stassen, Marjorie, Margaret Landstrom, and Ramona Lumpkin. "Students' Reactions to the Introduction of Videoconferencing for Classroom Instruction." The Information Society 14.2 (1998): 153-64.
Keywords: Distance education
College students with no experience with a videoconference course were surveyed at the beginning and end of a semester's course in seven different courses. There was no gender difference at the beginning. Women's attitudes were significantly less positive about taking a videoconference course at both the origination and remote sites in comparison with men and with their own attitudes at the beginning of the semester. (Reviewed abstract only)

Arnez, B.W., and M.J. Lee. "Gender Differences in the Attitude, Interest, and Participation of Secondary Students in Computer Use." American Educational Research Association. Boston, 1990.
Could not obtain: not reviewed.

Aronson, Joshua. "Stereotype Threat: Contending and Coping with Unnerving Expectations." Improving Academic Achievement: Impact of Psychological Factors on Education. Ed. Joshua Aronson. Educational Psychology Series. San Diego: Academic Press, 2002. 281-301.
Keywords: Stereotype threat, Research review
Great explanation of stereotype threat and summary of research on the topic.

---. "The Threat of Stereotype." Educational Leadership 62.4 (2004): 14-19.
Keywords: Stereotype threat
Excellent introductory article about stereotype threat: anxiety in evaluative contexts about the possibility of confirming a negative stereotype about one's group decreases performance, which seems to confirm the stereotype.

Atan, Hanafi, Nazirah A. Azli, Zuraidah A. Rahman, and Rozman M. Idrus. "Computers in Distance Education: Gender Differences in Self-Perceived Computer Competencies." Journal of Educational Media 27.3 (2002): 123-35.
Keywords: Distance education, Outside U.S., Postsecondary/tertiary
Distance education students at a university in Malaysia were studied. The researchers found no gender differences in competencies in the usage of general computer software and networking software, both needed to support and facilitate learning in distance education. However, competencies in handling computer hardware and performing computer maintenance favored males. (Reviewed abstract only)

Atan, H., F. Sulaiman, Z.A. Rahman, and R.M. Idrus. "Gender Differences in Availability, Internet Access and Rate of Usage of Computers among Distance Education Learners." Educational Media International 39.3-4 (2002): 205-10.

Keywords: Distance education, Telecommunications, Parents and home, Access

The study found no gender differences in the availability of computers, internet accessibility, and rate of computer use either at home or at work for distance education learners. (Reviewed abstract only)

Attewell, Paul, and Juan Battle. "Home Computers and School Performance." The Information Society 15.1 (1999): 1-10.

Keywords: Parents and home, Access, Race, ethnicity, or low SES

Access to home computers was studied in terms of performance in school math and reading; it was shown to have an educational payoff in comparison with children who had no such access. However, controlling for family income and for cultural and social capital, it was found that boys benefited more than girls, children from higher SES families more than those from lower SES families, and white children more than minority children. Home computing may therefore generate another "Sesame Street effect" whereby an innovation that held great promise for poorer children to catch up educationally with more affluent children in practice increases the gap between them. (Reviewed abstract only)

Ayersman, David J., and W. Michael Reed. "Effects of Learning Styles, Programming, and Gender on Computer Anxiety." Journal of Research on Computing in Education 28 (1995): 148-61.

Keywords: Programming, Pedagogy, Attitudes and expectations

Among undergraduate education majors, females significantly outperformed males on a hands-on programming task. There were no other gender differences. A four-week instruction reduced anxiety more than an intensive one-day format.

Badagliacco, Joanne M. "Gender and Race Differences in Computing Attitudes and Experience." Social Science Computer Review 8.1 (1990): 42-63.

Keywords: Experience, Culture, Classroom interactions, Attitudes and expectations, Postsecondary/tertiary

A survey of university students found that males have more computer experience and more positive attitudes about computers, in part because computing is seen as white and male and because of instructional biases.

Bakon, Cynthia, Antonia Nielsen, and Jamieson McKenzie. "Computer Fear." Educational Leadership September 1983 1983: 27.

Keywords: Programming, Use patterns, Secondary/high school

Survey of 10 NJ high schools in Princeton revealed male dominance in programming.

Bannert, Maria, and Paul Roland Arbinger. "Gender-Related Differences in Exposure to and Use of Computers: Results of a Survey of Secondary School Students." European Journal of Psychology of Education 11.3 (1996): 269-82.

Keywords: Methodology, Attitudes and expectations, Use patterns, Outside U.S., Middle school, Secondary/high school

1,035 students in grades 5-10 in Germany were surveyed. All measures favored boys. Boys owned a computer more than girls at all grade levels, had more experience with computers, used it more per day and for more purposes. Boys had a higher interest in computer activities, and while this interest declined slightly for boys over the five grades it declined more for girls. Boys perceived more control of the computer and more confidence in success, while girls perceived more expectation of failure. Methodological cautions: 1) while gender differences did exist and while they were statistically significant, they were of small practical value statistically. 2) Differences in computer-related motives may be caused by variables other than sex. 3) Other factors entirely may account for the gender differences more strongly. 4) Since research has established that boys often overestimate their computer-related abilities, students' self-ratings may be problematic.

Barbieri, Maria Silvia & Light, Paul H. "Interaction, Gender, and Performance on a Computer-Based Problem-Solving Task." Learning and Instruction 2 (1992): 199-213.

Keywords: Single-sex environment, Elementary/primary

Eleven- and 12-year-old children worked on computer problem-solving tasks in mixed-sex or single-sex pairs. Boys were dominant in interactions but less so in terms of final performance.

Barker, Lecia J., Kathy Garvin-Doxas, and Diane Sieber. Retaining Women in Computer Science: Learning from a Fine Arts Approach to Teaching. Boulder, CO: Alliance for Technology, Learning and Society, 2003.

Could not obtain: not reviewed.

Barrett, E., and V. Lally. "Gender Differences in an Online Learning Environment." Journal of Computer Assisted Learning 15.1 (1999): 48-60.

Keywords: Distance education, Telecommunications

Postgraduate students taking an online course were studied. Whie the cognitive (learning) content of the contributions did not differ by gender, men sent more messages, their messages were twice as long, and made more socio-emotional contributions than women. Women contributed more interactive messages. Conclusion" [t]the application of CMC [computer-mediated communication] technology to a specific learning context may reproduce gender differences within a learning community." (Reviewed abstract only)

Baumeister, Roy F., Jennifer D. Campbell, Joachim I. Kreuger, and Kathleen D. Vohs. "Exploding the Self-Esteem Myth." Scientific American January 2005.

Keywords: Attitudes and expectations

A review of research on self-esteem. There is essentially no evidence that self-esteem correlates with academic achievement. In a 1986 study with 23,000 high school students, self-esteem in 10th grade was only weakly predictive of academic achievement in the 12th grade, and vice versa not much better. These results are found in multiple studies, and some studies suggest that artificially boosting self-esteem may actually lower subsequent academic performance.

Beeson, Betty Spillers, and R. Ann Williams. "The Effects of Gender and Age on Preschool Children's Choice of the Computer as a Child-Selected Activity." Journal of the American Society for Information Science 36.5 (1985): 339-41.

Keywords: Preschool

No sex-stereotyping was observed among preschool children in the use of the computer.

Bennett, D. "Providing Role Models Online." Electronic Learning?? (1997): 50-51.

Could not obtain: not reviewed.

Benoit, Sallye S. et al. "Gender Fairness: Is It Prevalent in Career-Oriented Software?" Delta Pi Epsilon Journal 33 (1991): 106-16.

Could not obtain: not reviewed.

Bernhard, Judith K. "Gender-Related Attitudes and the Development of Computer Skills: A Preschool Intervention." Alberta Journal of Educational Research 38.3 (1992): 177-88.

Keywords: Single-sex environment, Preschool, Programming

The study was designed to determine computer-related attitudes "before stereotypic behavior patterns are firmly set." (p. 179) 59 preschool children in Alberta, Canada, ages 3-6, formed two experimental groups (male pairs and female pairs on the computer) and a non-computer control group also in single-sex pairs. For 6 weeks the children used LOGO on the computer; the control group did nature-related activities. Parents also completed questionnaires. Bys showed more stereotypic attitudes toward computers than girls. No age differences were found. Boys completed more computer tasks than girls. Boys behaved more avidly and inquisitively at the computer than the girls did. Girls' computer attitudes increased over the period in both the experimental and control groups. Since there were no mixed-sex groups, this study provides no information about single-sex/coed environments.

Bernstein, Danielle R. "A New Introduction to Computer Science." In Search of Gender-Free Paradigms for Computer Science Education. Eds. C. Dianne Martin and Eric Murchie-Beyma. Eugene, OR: International Society for Technology Education, 1992. 87-91.

Keywords: Attitudes and expectations

About self-efficacy.

Berstein, D. "The University of Wisconsin Women and Science Project: Is Computer Science Different from Other Sciences? Or Is Teaching Computer Science Different from Teaching Other Sciences?" Gates 4.1 (1997): 32-37.

Could not obtain: not reviewed.

Beynon, J. M., and H. Mackay. "Computers, Dominant Boys and Invisible Girls, Or "Hannah, It's Not a Toaster, It's a Computer"." Computers into Classrooms: More Questions Than Answers. Ed. J.M. Beynon. London: Falmer Press, 1993.

Could not obtain: not reviewed.

Bhargava, Ambika, Anna Kirova-Petrovna, and Shannan McNair. "Computers, Gender Bias, and Young Children." Information Technology in Childhood Education (1999): 263-74.
Keywords: Pedagogy, Parents and home, Software, Use patterns
Difference in computer use can be attributed to gender-biased classroom practices, lack of female role models, computer gender gap in homes, and the scarcity of bias-free software.

---. "Gender Bias in Computer Software Programs: A Checklist for Teachers." Information Technology in Childhood Education Annual 2002.1 (2002): 205-18.
Keywords: Software, Teachers and faculty
Gender bias exists in software in terms of characters (most are male and both sexes are presented in stereotypic roles), content (reflects male interests with a focus on adventure and sports, aggression and violence; complicated software frustrates inexperienced users, primarily girls), and reward systems (correct answers get male-oriented responses). A checklist is presented for teachers to use for evaluating educational software for gender bias.

Biernat, Monica, Melvin Manis, and Thomas E. Nelson. "Stereotypes and Standards of Judgment." Journal of Personality and Social Psychology 60.4 (1991): 485-99.
Keywords: Stereotypes and bias, Postsecondary/tertiary
College students were shown pictures of males and females and asked to rate them for height, weight, financial success, and age, either objectively (with numbers) or subjectively (as compared to an "average adult"). Objective judgments turned out to be much more gender stereotyped.

Blum, Lenore. "Building an Effective Computer Science Student Organization: The Carnegie Mellon Women@Scs Action Plan." SIGCSE Bulletin 34.2 (2002): 74-78.
Could not obtain: not reviewed.

---. "Transforming the Culture of Computing at Carnegie Mellon." Computing Research News 13.5 (2001): 2-9.
Keywords: Postsecondary/tertiary, Interventions, Critical mass, Barriers, Support groups
Description of what they did at Carnegie Mellon University to raise female enrollment from 7% to 37%, 1995-2001.

---. "Women in Computer Science: The Carnegie Mellon Experience." The Innovative University. Eds. Daniel P. Resnick and Dana Scott. Pittsburgh: Carnegie Mellon Press, 2004.
Could not obtain: not reviewed.

---. Women in Computer Science: The Carnegie Mellon Experience. The Future of the University: The University of the Future.
Keywords: Postsecondary/tertiary, Curriculum, Culture, Outreach, Support groups
Success story at Carnegie Mellon University: Women@SCS Advisory Council, culture changes, experience gap.

Blum, Lenore, and Carol Frieze. "The Evolving Culture of Computing: Similarity Is the Difference." Frontiers: A Journal of Women Studies 26.1 (2005).
Keywords: Curriculum, Culture, Programming, Postsecondary/tertiary, Experience
"Recommendations for curricular changes based on presumed gender differences can be misguided and may help reinforce, even perpetuate, stereotypes." As the environment becomes more equalized by sex, breadth of interests, and professional experiences, the culture changes in ways that are positive for women and men. They claim very different conclusions from those of Jane and Allan in interviews with the last class of CS women to enter CMU as a distinct minority (class of 2002), who were affected by the larger number of women in succeeding years: "a class in transition." Unlike what Jane Margolis and Allan Fisher found, there was less geekiness, students were more well-rounded, and there were more similarities between males and females.

Bohonak, Noni McCullough. "Attracting and Retaining Women in Graduate Programs in Computer Science." Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics, and Engineering. Ed. Sue V. Rosser. New York: Teachers College Press, 1995. 169-80.
Keywords: Postsecondary/tertiary, Outreach, Retention, Pipeline, Culture, Stereotypes and bias, Race, ethnicity, or SES
Few graduate programs have support mechanisms for female students for outreach or retention. Foreign students and faculty often come from cultures that discount women. CS departments use freshman courses for filtering out students. Minority women have cultural and financial problems. There is a need for well-funded programs for women and minorities.

Bolan, Sandra. "Girls Learn It Bits and Bytes." Computing Canada March 28 2002: 18.

Keywords: Role models and mentors
Event for girls in IT featured a woman in IT as a role model.

Borg, Anita. "What Draws Women to and Keeps Women in Computing?" Annals of the New York Academy of Sciences (1999).
Could not obtain: not reviewed.

Borgo, Suzanne Lavon. "Ideology and Science: An Interpretive Analysis of Research on Gender, Computers and Education." Ph.D. dissertation. University of Virginia, 1993.
Keywords: Extracurricular programs, Research review, Attitudes and expectations, Use patterns
Research review on computer equity, particularly in out-of-school activities, interest, and use vs. attitude.

Boudria, Theodore J. "Implementing a Project-Based Technology Program for High School Women." Community College Journal of Research and Practice 26 (2002): 709-22.
Keywords: High school learning & achievement, Extracurricular programs
The Women in Technology (WIT) program, based at Bristol Community College in Fall River MA, included field trips to colleges and businesses, workshops on leadership and team building skills, shadowing TI women, attending a summer engineering and technology camp, and an 8-month project-based learning experience at TI. 65% of the 1997-98 graduates went to college in an engineering or CS major.

Bourque, Susan C., and Kay B. Warren. "Technology, Gender, and Development." Daedalus 116.4 (1987): 173-97.
Keywords: Culture
Schools are unlikely to achieve gender equity in technology without radical institutional change, since both schools and technology are male-dominated cultures.

Bradshaw, Jackie, Sue Clegg, and Deborah Trayhurn. "An Investigation into Gender Bias in Educational Software Used in English Primary Schools." Gender and Education 7.2 (1995): 167-74.
Keywords: Software, Outside U.S., Elementary/primary
Very interesting experiment. 200 5- & 6-year-olds played two educational software games. They were asked about androgynous figures 3 times: 1st at first contact, 2nd when the interviewer asked if a figure was a boy or a girl, and 3rd when the interviewer asked if the kid might reconsider the gender assignment of the figure. First-time identifications were overwhelmingly male. Second time still very male but girls were somewhat more likely to say the figure was a girl. Third time nearly half the kids were willing to reconsider gender assignments. Conclusion: teacher interventions can be effective in helping girls achieve female identifications with computer software.

Brady, Holly, and Twila Slesnick. "Girls Don't Like Fluffware Either." Classroom Computer Learning April/May 1985 1985: 20-28.
Keywords: Software
"Girl" software is stereotyped.

Bravo, Melinda J., Lucia Albino Gilbert, and Lisa K. Kearney. "Interventions for Promoting Gender Equitable Technology Use in Classrooms." Teacher Education Quarterly 30.4 (2003): 95-109.
Keywords: School programs, Attitudes and expectations, Pedagogy, Teacher education
They had middle-school kids act out two skits (a kid trying to join a group of boys at the computer, a newly hired team leader in a computer game development firm), with discussion. They did two collaborative activities (true/false has students give evidence on stereotypes about gender and computers; and another to reinforce girls as designers and leaders of technology), with discussion. 7th grade teachers felt both girls and boys had reduced gender-stereotyped attitudes and behavior.

Breene, L. Anne. "Women and Computer Science." Initiatives 55.2 (1992): 39-44.
Keywords: Culture, Stereotypes and bias, Outside U.S.
Foreign-born CS professors often have cultural biases against women.

Broihier, M. et al. "Children and Computers: Do Sex-Related Differences Persist?" Journal of Communication 39.3 (1989): 85-93.
Could not obtain: not reviewed.

Brosnan, Mark. "Design Factors Affecting Gender Issues in Human-Computer Inteaction." University of Manchester, 1994.
Could not obtain: not reviewed.

---. "New Methodology and Old Story? Gender Differences in The "Draw a Computer User" Test." European Journal of Psychology of Education 14.3 (1999): 375-85.
Could not obtain: not reviewed.

Brosnan, M., and M. Davidson. "Psychological Gender Issues in Computing." Journal of Gender, Work and Organization 3.1 (1996): 13-25.
Could not obtain: not reviewed.

Brosnan, Mark, and Wanbil Lee. "A Cross-Cultural Comparison of Gender Differences in Computer Attitudes and Anxieties: The United Kingdom and Hong Kong." Computers in Human Behavior 14.4 (1998): 559-77.
Keywords: Attitudes and expectations, Cross-cultural, Outside U.S.
In the UK sample, there were no gender differences in computer anxiety, but males held more positive attitudes than females. For the Hong Kong sample, it was the reverse: there were no gender differences in computer attitudes but males reported greater computer anxiety than females, especially when anticipating using computers (as opposed to actually using them). "This is the first sample in which males have been found to be more computer anxious than females." (Reviewed abstract only)

Brosnan, Mark J. "Computerphobia: Is It a Particularly Female Phenomenon?" The Psychologist 7 (1994): 73-78.
Keywords: Postsecondary/tertiary, Attitudes and expectations, Stereotypes and bias, Experience, Research review, Culture
A 1994 research review of "computerphobia." Fewer women enter CS, but those who do and stay do as well as the men. From the 80s to the 90s, explanations of the computer gap moved from biological explanations (males' aggressiveness, superior spatial relations ability) to social ones. Attitudinal factors ("computer anxiety") almost become psychiatric disorders! Discusses attitude vs. experience as predictive factor for participation. There is not agreement on the relative strength of attitude, experience, and related factors.

---. "The Impact of Psychological Gender, Gender-Related Perceptions, Significant Others, and the Introducer of Technology Upon Computer Anxiety in Students." Journal of Educational Computing Research 18.1 (1998): 63-78.
Keywords: Attitudes and expectations, Use patterns, Games, Programming, Outside U.S.
119 first-year UK college students took a computer anxiety questionnaire and the Bem Sex Role Inventory. Females were significantly more computer anxious than males. Males reported twice the number of hours on the computer per week than females, especially games and programming. The more anxious students had less experience. High-femininity males scored higher for computer anxiety, and high-masculinity females scored lower for computer anxiety. Females were more likely than males to perceive computing as a male activity. For students who owned home computers, more fathers than mothers used it. Females were more likely to be introduced to computers by a teacher than by a friend or family member, which was the case for males. Introduction to computers by a teacher was associated with higher computer anxiety.

---. "The Role of Psychological Gender in the Computer-Related Attainments of Primary School Children (Aged 6-11)." Computers and Education 30.3-4 (1998): 203-08.
Keywords: Attitudes and expectations, Stereotypes and bias, Role models and mentors, Elementary/primary
Forty-eight children, aged 6 to 7 and 10 to 11, were given the Bem Children's Sex Role Inventory to assess masculinity and femininity, a test to assess children's attitude toward computers, and a computer skill performance test. Males had more positive attitudes and higher attainment levels than females, but rather than the children's sex it was their masculinity/femininity rating that was more predictive of computer attitude and skill. In a society that masculinizes computing, children of both sexes with high masculinity were more positive about computers and achieved higher skill levels than children with high femininity. "[P]sychological gender is a more salient factor determining differences in computer attainment than biological sex." (p. 206) Providing computer-confident role models for girls is especially important.

Brown, Bettina Lankard. Women and Minorities in High-Tech Careers, 2001.
Keywords: Career factors, Race, ethnicity, or low SES, Curriculum, Outreach, Pedagogy
Summary of ways to interest girls and minorities in IT: connect to their interests, involve business, provide career info, collaborative learning, introduce in middle school, mentors/role models

Brownhill, Carrie. "Factors Affecting the Decisions of Women to Enter Doctoral Programs in Computer Science." University of California at Irvine, 1989.

Could not obtain: not reviewed.

Brunner, Cornelia. Gender and Distance Learning. New York: Bank Street College of Education, 1992.

Keywords: Culture, Telecommunications, Attitudes and expectations

Women fantasize about small appealing objects that allow them to collaborate, create, share work, and integrate home and work lives. Men wish for magic wands that give them power, speed, and wisdom.

Brunner, Cornelia, and Dorothy Bennett. "Technology and Gender: Differences in Masculine and Feminine Views." NASSP Bulletin 81 (1997): 46-51.

Keywords: Culture, Pedagogy, Curriculum, Programming, Telecommunications

Because boys tend to find technology useful as an end in itself and girls find it useful as a means to an end, technology would be more attractive to girls if presented as a means to an end.

---. "Technology Perceptions by Gender." Education Digest 63.6 (1998): 56-58.

Keywords: Programming, Culture, Attitudes and expectations

Students aged 11 to 18 were asked about their feelings and fantasies about technology. "Feminine fantasies are about small, flexible objects that can be worn or carried easily and that allow women to communicate and connect and to share ideas and stories. Masculine fantasies are about magic wands (or brain implants) that allow men to transcend the limitations of time and space." (pp. 56-57) Girls focus on the computer's social function and boys on the machine itself, so presenting the computer as an end in itself, as in programming, might be of less interest to girls than would presenting it as a tool for solving social problems.

Bryson, Mary, and Suzanne de Castell. "Learning to Make a Difference: Gender, New Technologies, and in/Equity." Mind, Culture, and Activity: An International Journal 3 (1996): 119-35.

Could not obtain: not reviewed.

---. "New Technologies and the Cultural Ecology of Primary Schooling: Imagining Teachers as Luddites in/Deed." Educational Policy 12.5 (1998): 542-67.

Keywords: Teachers and faculty, Stereotypes and bias, Pedagogy, Outside U.S., Elementary/primary

In interviews with teachers and administrators in elementary schools in British Columbia, most denied that gender was a consideration in terms of technology in their school but went on to accept gender-stereotyped differences. They preferred to explain technology-user differences with left-brained vs. right-brained reasons than anything dealing with gender. Both men and women shared the stereotypes, and some teachers and computer coordinators said they taught computers differently according to whether the students were primarily male or female.

---. "So We've Got a Chip on Our Shoulder! Sexing the Texts Of "Educational Technology"." Gender in/Forms Curriculum: From Enrichment to Transformation. Ed. Jane & Willinsky Gaskell, John. New York: Teachers College Press, 1995. 21-42.

Keywords: Culture

The chapter describes four concepts of gender as it relates to educational technology. 1) The positivistic conception is equivalent to biological sex. 2) The constructivist conception is socially produced and sustained. 3) The critical conception is the ideological product of a repressively patriarchal hegemony. 4) The postmodern conception is a noncohesive, open-textured pastiche of characteristics, aptitudes, and dispositions whose ongoing construction and reconstruction is a central task of feminist praxis.

Bryson, Mary et al. "Conditions for Success: Gender in Technology-Intensive Courses in B.C." Canadian Journal of Math, Science, and Technology Education 3.2 (2003): 185-94.

Could not obtain: not reviewed.

Buckley, Jeanne. "Hard Disc, Ram-Drive, Cold Boot and Score ... Or Why Sally Won't Compute." Research review. Teachers College, Columbia University, 1988.

Keywords: Culture, Software, Curriculum, Language and terminology

Survey of research conducted between 1983 and 1987 on children's gender-specific responses to computers and educational software.

Bumgarner, Marlene Anne. "One Mother's Sampler of Programs That Her Girls Go For." Family Computing August 1984 1984: 42-46.

Keywords: Software

Tips on the kinds of software girls like.

Bunderson, Eileen D., and Mary Elizabeth Christensen. "An Analysis of Retention Problems for Female Students in University Computer Science Programs." Journal of Research on Computing in Education 28.1 (1995): 1-15.

Keywords: Postsecondary/tertiary, Attitudes and expectations, Culture

One factor responsible for females' opting out of computer science is lack of prior experience, plus gender-biased attitudes and behavior and nature of computer science as a discipline.

Burge, E.J. "Women as Learners: Issues for Visual and Virtual Classrooms." The Canadian Journal for the Study of Adult Education 4.2 (1990): 1-24.

Could not obtain: not reviewed.

Burger, Carol J. "Helping Girls Take a Byte out of Technology." Principal 81.3 (2002): 42-43.

Keywords: Attitudes and expectations, Parents and home, Pedagogy, Curriculum

Work with parents, try programs that work with girls, make pedagogy girl-friendly, collaborative learning, social relevance, mentors, cross-disciplinary curriculum.

Burstyn, Joan. ""Who Benefits and Who Suffers": Gender and Education at the Dawn of the Age of Information Technology." Gender in Education. Ed. Sari Knopp & Pollard Biklen, Diane. Chicago: National Society for the Study of Education, 1993. 107-25.

Keywords: Culture, Games, Parents and home, Curriculum, Telecommunications

Computers are associated with boys. Counteract this by infusing computers throughout the curriculum and using them differently.

Busch, Tor. "Gender Differences in Self-Efficacy and Attitudes toward Computers." Journal of Educational Computing Research 12.2 (1995): 147-58.

Keywords: Attitudes and expectations, Programming, Games, Parents and home, Experience

After a computer course, college students completed a questionnaire. Results indicated gender differences in perceived self-efficacy regarding completion of complex tasks in word processing and spreadsheet software, but no gender differences regarding simple computer tasks. Males had more prior experience in programming and games, and reported more encouragement from parents and friends. Contains a vast number of references on self-efficacy.

---. "Gender, Group Composition, Cooperation, and Self-Efficacy in Computer Studies." Journal of Educational Computing Research 15.2 (1996): 125-35.

Keywords: Pedagogy, Experience, Attitudes and expectations, Outside U.S.

150 Norwegian college students were studied. Females had less prior computer experience and reported lower levels of self-efficacy in computing and less prior encouragement to work with computers. Females received more task-related help and gave less than male students.

Business and Education Division, Capitol Publications. "High School Girls Shown Superior at Computer Programming." Education Daily (1985): 3.

Keywords: Secondary/high school, Programming, Culture

Article cites study by Ronald Anderson in Minnesota, who found 55% of the girls got the answer right to a programming question but only 40% of the boys, perhaps because females seem to be better at following explicit instructions.

---. "Sex Equity in Computer Education a Hot Topic of Debate." Education Daily 19.9 (1986): 1-2.

Keywords: Barriers

Notable only for the title and the date.

Butler, Deborah H. "Gender, Girls, and Computer Technology: What's the Status Now?" The Clearing House 73.4 (2000): 225-29.

Keywords: Middle school, Attitudes and expectations

Review of recommendations to decrease computer gender gap from research published in the 1990s.

Caftori, Netiva. "Examination of Computer Software in Relation to Gender Differentiation." Journal of Women and Minorities in Science and Engineering 1.3 (1994): 237-52.

Keywords: Software

A questionnaire administered to 60 students in grades 1-3 to determine characteristics in educational software to which the responses of girls and boys differ found few such characteristics and that gender differences were minor.

California State Department of Education. "Computer Usage — Key to Educational Equity." Sex Equity in Education Update 7.1 (1985): 1-4.

Keywords: Early work

Overview of what was known in 1985; reprints of other articles.

Callan, J.M. "Attitudes toward Computers: The Gender Gap Revisited." 9th International Conference on Technology and Education. Paris, France, 1992.

Could not obtain: not reviewed.

Calvert, Sandra L., J. Allen Watson, Vickie M. Brinkley, and Barbara Bordeaux. "Computer Presentational Features for Young Children's Preferential Selection and Recall of Information." Journal of Educational Computing Research 5.1 (1989): 35-49.

Keywords: Software, Preschool

Among preschoolers, boys were significantly more likely to prefer software with action (in this case, moderate movement) than girls were.

Camp, Tracy. "A Decade in the University Pipeline." Computing Research News (1997).

Keywords: Pipeline

The pipeline shrinkage problem for women.

---. "The Incredible Shrinking Pipeline." Communications of the ACM 40.10 (1997): 103-10.

Keywords: Postsecondary/tertiary, Pipeline

Computer science departments in colleges of engineering graduate fewer women than CS departments in non-engineering colleges. Article reviews decrease in female participation at the bachelors level over the years.

---. "The Incredible Shrinking Pipeline Unlikely to Reverse." Report (2000)

Keywords: Postsecondary/tertiary, Pipeline

Computer science loses women as they move through high school, college, graduate school, and academia.

Campbell, Caty, and Stanley Varnhagen. "When Faculty Use Instructional Technologies: Using Clark's Delivery Model to Understand Gender Differences." Canadian Journal of Higher Education 32.1 (2002): 31-56.

Keywords: Teachers and faculty, Pedagogy, Telecommunications, Distance education, Outside U.S.

A post-hoc survey of higher education faculty in Canada with a 21% return rate finds that female faculty may use different educational and informational technologies for different purposes than their male colleagues in terms of increased emphasis on a teaching role, their tendency to explore more relational approaches to teaching, and their experience with technology as female learners and teachers.

Campbell, J.R. "The Roots of Gender Inequity in Technical Areas." Journal of Research in Science Teaching 28.3 (1991): 251-64.

Could not obtain: not reviewed.

Campbell, Katy. "Gender and Educational Technologies: Relational Frameworks for Learning Design." Journal of Educational Multimedia and Hypermedia 9.2 (2000): 131-49.

Keywords: Culture, Pedagogy, Telecommunications, Distance education,

Instructional design in education uses technologies that reflect androcentric values. It needs to be changed to support women's ways of knowing.

Campbell, N.Jo. "Computer Anxiety of Rural Middle and Secondary School Students." Journal of Educational Computing Research 5.2 (1989): 213-20.

Keywords: Attitudes and expectations

In a survey, sex differences were found in home availability of computers but not school computers. The findings suggest that computer anxiety is not affected by sex or school level when home availability and school use of a computer are statistically controlled.

Campbell, N. Jo. "Correlates of Computer Anxiety of Adolescent Students." Journal of Adolescent Research 3.1 (1988): 107-17.

Keywords: Attitudes and expectations, Mathematics

1,075 students in grades 5-12 were tested for computer anxiety. There were no significant differences between males and females in factors of perceived effect of computer ability on interpersonal relationships (the most significant predictor of computer anxiety for both sexes), fear of computer hardware, availablity of a home computer, perceived relationship between math and computer abilities, and perception of a relationship between computing and gender. Availability of a school computer was significant only for females.

---. "Enrollment in Computer Courses by College Students: Computer Proficiency, Attitudes, and Attributions." Journal of Research on Computing in Education 25.1 (1992): 61-74.

Keywords: Attitudes and expectations, Postsecondary/tertiary

195 U.S. college freshmen and sophomores enrolled in a career awareness class that was designed for students without clear career goals completed questionnaires about computer attributions (variant of Fennema scale) and computer attitudes. The data was correlated with the number of semesters of college computer courses taken by each student. Females viewed computers as a male domain less than males.

---. "High School Students' Computer Attitudes and Attributions: Gender and Ethnic Group Differences." Journal of Adolescent Research 5.4 (1990): 485-99.

Keywords: Attitudes and expectations, Race, ethnicity, or SES, Secondary/high school

171 high school students in the US were surveyed about computer attitudes and attributions, the latter a modified Fennema scale that substituted computers for mathematics, based on Weiner's four-cell model — stability, effort, task difficulty and environmental (e.g. luck). Males and females and whites and minorities did not differ on the number of computer courses completed or planned. Ethnicity did not affect students' attributions of computer success but gender did. Males were more likely to attribute success to ability while females attributed it to environmental factors such as the effectiveness of the teacher and helpfulness of other students.

Campbell, Patricia B. "The Computer Revolution: Guess Who's Left Out?" Interracial Books for Children Bulletin 15.3 (1984): 3-6.

Keywords: Access, Programming, Race, ethnicity, or SES, Barriers, Software

Keywords describe article.

---. "Girls, Boys, and Too Few Computers." Sex Roles: A Journal of Research (n.d.).

Keywords: Use patterns, Mathematics, Access, Race, ethnicity, or SES

With few computers in schools in the mid-80s, access limitations often excluded girls. Association with math excluded girls, as did boys' selection by teachers as computer helpers and boys' aggressiveness around a scarce resource. Experiment with 81 5th and 6th grade kids in summer at which each kid spent 1 hour/day on their own computer: by the end girls' interest in computers grew to the point that sex differences disappeared.

---. "Hidden Equity: Incorporating Equity in Existing Computer-Based Programs." American Educational Research Association. Chicago, 1985.

Keywords: Access, School programs, Race, ethnicity, or low SES

How girls' interest in computers increased in three schools: requiring an introductory computer class, multiple uses in a six-week summer program, and teachers speaking individually to girls about computers.

---. "Personal Communication." 2004.

Keywords: Career factors, Pedagogy, Programming

In a survey of adult career-changers into information technology and IT workers, it was found that workers were doing the same sort of work regardless of the educational path they took to get there. Women were found to have more encouragement into IT than men. Women were more likely to have learned programming from having someone show them, while men were more likely to learn by reading programming books.

---. "Preliminary Guidelines for Selecting Computer Software." Interracial Books for Children Bulletin 15.5 (1984): 15-16.

Keywords: Software

Guidelines for selecting software that encourages girls and children of color.

Campbell, Patricia B., and Sonia Gulardo. "Computers in Education: A Question of Access." Computers in the Schools 1.1 (1984): 57-65.

Keywords: Access, Barriers, Race, ethnicity, or SES

Access issues for girls and children of color. Includes recommended introductory lesson plans.

Campbell, Patricia B., and Susan Jo Russell. "Microcomputers and Women's Educational Equity." Hands On! 7.1 (1984): 16-21.

Keywords: Barriers, Software, Use patterns, Access, Culture, Race, ethnicity, or SES

Keywords say it all: overview

Campbell, Patricia B., and Jo Sanders. "Challenging the System: Assumptions and Data Behind the Push for Single-Sex Schooling." Gender in Policy and Practice: Perspectives on Single-Sex and Coeducational Schooling. Eds. Amanda Datnow and Lea Hubbard. New York: Routledge Falmer, 2002. 31-46.

Keywords: Single-sex environment, Research review

Reviews the research behind common assumptions in favor of single-sex schooling. Bottom line: research is collectively inconsistent and inconclusive.

Canada, Katherine, and Frank Brusca. "The Technological Gender Gap: Evidence and Recommendations for Educators and Computer-Based Instruction Designers." Educational Technology Research and Development 39.2 (1991): 43-51.

Keywords: Research review, Pedagogy, Single-sex environment, Curriculum, Software

Because history and research indicate that the technological gender gap is not biologically predetermined, educators should adopt a proactive stance, structure the physical and social environments of computer facilities to enhance females' learning opportunities (collaborative, social learning, female-only computer times), integrate computing and programming across the curriculum, and eliminate sexist stereotyping from software. "[I]t is not necessarily computers and technology per se that females avoid, but rather the competitive, male environment that surrounds the field." (p. 47)

Cardman, Elizabeth R. The Gender Gap in Computer Use and Implications for Libraries. Independent study paper at the Graduate School f Library and Information Science, University of Illinois at Urbana-Champaign.

Keywords: Use patterns, Postsecondary learning & achievement

The gender gap in computing creates concern about unequal library use as libraries become computerized.

Carey, R.F. "Patterns of Microcomputer Use by Secondary School Students at Home and School." Doctoral dissertation. University of Oregon, 1985.

Keywords: Use patterns, Parents and home, Secondary/high school

Review of dissertation: survey of 1,000 high schools. Males were primary computer users at school and home. The review was published in The Computing Teacher, March 1986.

Carter, Janet, and Tony Jenkins. "Gender and Programming: What's Going On?" SIGCSE (Special Interest Group in Computer Science Education), 1999.

Keywords: Programming, Males, Critical mass, Interventions, Postsecondary/tertiary, Outside U.S.

In the School of Computer Science at the University of Leeds, a series of tutoring sessions was offered to all students who applied for them. Typically half the incoming students had no prior programming experience and typically about 20% of the students were female. However, women were about 80% of the tutoring students. The tutoring sessions were successful in helping these students pass the programming course. When it was discovered that some male students believed the sessions were only for women, the Leeds experience was contrasted with the University of Kent, which had a similar programming course and similar programming students but no tutoring sessions. In a survey of students at both universities, students at Leeds but not at Kent believed that the lecturers were more willing to help female students than male students, and this was especially for male students under age 21. This was obviously an unintended negative consequence of trying to help all students while primarily women took advantage of the offer. "Positive discrimination was not the intention, and as we are not able to address the underlying causes, a more male friendly approach is also required to redress the balance, and to actually help the male students who are struggling." (p. 3)

---. "What They Think: Students' Preconceptions of Computing." International Conference on Engineering Education. Oslo, Norway, 2001.

Keywords: Attitudes and expectations, Single-sex environment, Outside U.S., Postsecondary/tertiary

348 students taking a computer course who were not CS majors were surveyed at two UK universities. Women were slightly under-represented in comparison with their presence in the student bodies (48% to 53% and 55%). Female students who had attended single-sex schools previously had more computer confidence than those who had attended co-ed schools.

Cartwright, A., and P. Colville. "A Mentor Scheme for Bachelor of Computing Students." Women in Computing: Broadening the Network. Brisbane, QUT, 1994. 1-11.

Could not obtain: not reviewed.

Cassidy, Simon, and Peter Eachus. "Developing the Computer User Self-Efficacy (Cuse) Scale: Investigating the Relationship between Computer Self-Efficacy, Gender and Experience with Computers." Journal of Educational Computing Research 26.2 (2002): 133-53.

Keywords: Experience, Attitudes and expectations, Methodology

Article describes the development and validation of the scale. Computer self-efficacy (CSE) was correlated with computer experience; males showed significantly higher CSE than females, even when females were equally highly experienced. Perceived masculinity of the computer task, unlike other studies, was not the determining factor in gender differences in CSE, since the gap showed up with all tasks and at all experience levels.

Castaneda, Sheila. "Collaborative Research Experience for Women." Computing Research News (1999).

Keywords: Interventions, Postsecondary learning & achievement, Context, Retention

Describes program to provide collaborative research experiences for groups of 2 or 3 women in CS, with stipends, in the hope that enabling women to do research collaboratively and not in isolation will increase retention.

Center for Educational Equity. Introduction to Courseware Bias Evaluation Form: American Institutes for Research, n.d.

Keywords: Software

Software evaluation form for bias in terms of gender and race/ethnicity.

Chabot Space and Science Center. Techbridge: Encouraging Girls in Technology. 2004. Available: http://www.chabotspace.org/visit/programs/techbridge.asp, retrieved December 1, 2004.

Keywords: Interventions, Role models and mentors, Teacher education, Parents and home

2000-2003 project for elementary, middle school and high school girls that included role models, teacher training, family involvement, and research on factors that encourage girls to enter technology careers.

Chambers, S.M., and V.A. Clarke. "Is Inequity Cumulative? The Relationship between Disadvantaged Group Membership and Students' Computing Experience, Knowledge, Attitudes, and Intentions." Journal of Educational Computing Research 3.4 (1987): 495-518.

Keywords: Race, ethnicity, or SES, Outside U.S., Attitudes and expectations, Experience

951 elementary and secondary students in Australia were pre-tested, given computer experiences the first year computers were introduced into the schools, and then post-tested. Four types of disadvantage were considered: gender, school ability, SES, and ethnic background. By the end of the year, girls, high-ability students, and non-Australian students (defined as ethnic minorities) had lower attitude scores than at the start, while high and low SES students did not vary appreciably start to finish. The more disadvantaged groups a student belonged to, the less likely he or she was to have a computer at home, to use non-school computers, to have written a computer program, and to say they would have liked to have more help from the computer teacher and were less likely to have non-class computer experience and computer knowledge, so there was a cumulative effect. The more disadvantaged students participated in fewer computing activities than other students in the same schools. Non-class computer experience and computer attitudes were significant predictors of school computer experience, but initial computer knowledge was not. Intention to participate in future computer studies lessened with the number of disadvantaged groups a student belonged to (though not statistically significant).

Chan, May Sok-ching, and Lydia Kam-ha Leung. A Comparison of Students' Perceptions of Using Computers between Conventional Undergraduate Students and Distance Learners.

Keywords: Distance education, Attitudes and expectations, Outside U.S., Postsecondary/tertiary

Two groups of students were surveyed in Hong Kong, none majoring in computers. Students at the Polytechnic University of Hong Kong (traditional classrooms) were taking social work and accounting courses; those at the Open University of Hong Kong (distance education) were taking a statistics course. Women were 40% of the former and 20% of the latter. There was no gender difference in attitude about learning using computers.

Chan, Vania, Katie Stafford, Maria Klawe, and Grace Chen. "Gender Differences in Vancouver Secondary Students' Interests Related to Information Technology Careers." Canadian Coalition of Women in Engineering, Science, Trades, and Technology, 2000.

Keywords: Career factors, Attitudes and expectations, Parents and home, Use patterns, Outside U.S., Secondary/high school

Canadian high school students were surveyed about factors leading to career choice. Females indicated less interest and perceived ability than males, reported spending less time on computers at school and home, and gave lower estimates of their computer skills than males. Interest correlated with perceived ability. The two sexes had different computer use patterns both in

school and outside of school, with males using them more for surfing the net, programming and games, and female more for assignments; e-mail was slighly more male at school and slightly more female at home. Females rated themselves substantially lower in systems and hardware, programming, and applications, and slightly lower in basic operation. Neither males nor females had much knowledge of the skills and personality characteristics needed for success in IT careers. Conclusion: "low interest and perceived ability are strong factors underlying the low participation of women in CS."

Chappell, Kelly K. "Mathematics Computer Software Characteristics with Possible Gender-Specific Impact: A Content Analysis." Journal of Educational Computing Research 15.1 (1996): 25-35.

Keywords: Software, Elementary/primary, Middle school, Secondary/high school, Mathematics

The study analyzed 17 top-selling math software programs at different grade levels. The percentage of female characters decreased with grade level. Violence and competitiveness (against the program and peer-against-peer) increased with grade level.

Charles, Maria, and Karen Bradley. "A Matter of Degrees: Female Underrepresentation in Computer Science Programs Cross-Nationally." Women and Information Technology: Research on the Reasons for Underrepresentation. Eds. Joanne McGrath Cohoon and William C. Aspray. Cambridge MA: MIT Press, 2005.

Keywords: Cross-cultural, Outside U.S., Postsecondary/tertiary, Culture

In an analysis of data from the Organisation for Economic Cooperation and Development of tertiary first-degree graduates in 31 fields in 21 industrialized countries (mostly affluent western countries), the authors aggregated 30 fields and compared them to computing. Women are underrepresented in computer science programs in all 21 countries, with Turkey, Ireland and Korea coming closest to equal and the Czech Republic, the Slovak Republic and Germany being the most unequal. There is "striking cross-national uniformity in the sex-typing of computer-science programs." They found no correlation between women's representation in CS and a country's level of economic development, or a country's rate of women's presence in the labor force, higher education, or professional occupations. There is also no correlation between women's representation in CS and gender-egalitarian attitudes: women's CS representation is relatively strong in Korea, Ireland and Turkey, countries that score low on the "liberal egalitarian" measure. They conjecture that in countries where women have most choice, gender stereotypes lead them to make stereotyped choices, in opposition to countries where the national government strongly influences "curricular trajectories" by means of required courses. "Restrictive government practices that minimize choice and prioritize merit may actually result in more gender-neutral distribution across fields of study" by overriding the effects of gender stereotypes.

There is a correlation in countries where 8th grade girls express greater interest in pursuing a math career, which suggests a cultural influence. This is not due to ability since there is no correlation between the girls' math aspirations and their math achievement. Sex segregation in computing and other occupations is linked to "deeply rooted cultural assumptions about gender difference." (No page references since this is a pre-publication copy).

Charlton, John P. "Biological Sex, Sex-Role Identity, and the Spectrum of Computing Orientations: A Re-Appraisal at the End of the 90s." Journal of Educational Computing Research 21.4 (1999): 393-412.

Keywords: Attitudes and expectations, Use patterns, Outside U.S., Postsecondary/tertiary

Male and female undergraduates in England were given the Bem Sex-Role Inventory. Students scoring high-masculine and high-feminine had greater comfort (opposite of anxiety). Higher masculinity scores were related to greater engagement (use), and higher femininity scores were related to lesser over-use. Males in general were prone to over-use regardless of masculinity or femininity. Conclusion: greater female negativity toward computers is waning, partly due to the expansion of computer applications into non-male-dominated areas such as inter-personal communications. We can expect some reductions in sex imbalances in computing course enrollments, although perhaps only marginally.

Cheek, Dennis W., and Susan Agruso. "Gender and Equity Issues in Computer-Based Science Assessment." Journal of Science Education and Technology 4.1 (1995): 75-79.

Keywords: Applications

Using a computer in assessment poses a burden on females and other groups for whom the computer is problematic.

Chen, Milton. "Gender and Computers: The Beneficial Effects of Experience on Attitudes." Journal of Educational Computing Research 2.3 (1986): 265-82.

Keywords: Experience, Attitudes and expectations, Role models and mentors, Culture, Parents and home

Students at five Bay-area high schools in California were surveyed. Males had greater total exposure to computers, mostly due to higher enrollment in school programming classes and home computer use, and had more positive attitudes toward computers. Males reported a stronger presence of friends and peers in computing. When computer experience was held constant, however, females and males had similar levels of interest in computers.

Ching, Cynthia Carter, Yasmin B. Kafai, and Sue K. Marshall. ""I Always Get Stuck with the Books": Creating Space for Girls to Access Technology in a Software Design Project." Ghosts in the Machine: Women's Voices in Research with Technology. Eds. Nicola Yelland and Andee Rubin. New York: Peter Lang Publishing, Inc., 2002. 167-89.

Keywords: Software, Access, Context

26 5th and 6th grade students formed small groups that varied in terms of design experience, gender, grade level, and classroom leadership (as indicated by teacher). They build an interactive multimedia resource about astronomy for younger students, using Microworlds LOGO. At first boys used computers more than girls and girls used paper-based activities more than boys, but by the 8th week the sex differences evened out. The authors believe this is so because of their and the teacher's active interventions, although there was no control group. Interventions were 1) "social space": group meetings every 10 days where every student had a chance to say what was bothering them and then the group discussed it. All groups chose to make a computer schedule. This seemed to benefit both boys and girls. 2) "physical space": adults made computers in the adjoining computer lab available and many girls used it on a daily basis, while boys preferred to stay at the isolated computers in the classroom.

---. "Spaces for Change: Gender and Technology Access in Collaborative Software Design." Journal of Science Education and Technology 9.1 (2000): 67-78.

Keywords: Software, Pedagogy

Mixed teams of 10- to 12-year old children designed multimedia astronomy software and other resources for younger students. The configuration of social, physical, and cognitive "spaces" in the project environment increased girls' levels of access. (Reviewed abstract only)

Chivers, G. "Information Technology — Girls and Education: A Cross-Cultural Review." Women and Information Technology. Ed. M.J. Davidson & C.L. Cooper. London: John Wiley, 1987. 13-32.

Could not obtain: not reviewed.

Christensen, Rhonda. "Girls and Computers: Who Says Boys Enjoy Them More?" National Educational Computing Conference. Seattle, Washington, 2003.

Keywords: Attitudes and expectations

The study was concerned with boys' and girls' attitudes toward computers in Texas. Within two years over 3,000 K-12 students took an online questionnaire. There was no consistent attitude difference between males and females through 5th grade (5th grade girls actually enjoyed computers a little more than boys), but starting in grade 6 male scores were consistently more positive than females'. However, this was created more by a decline in girls' attitude scores than an increase in boys'. "The data is sufficiently consistent that it is time for this myth [that boys enjoy computers more than girls] to cease to exist." (p. 8)

Christie, Alice Atkinson. Boys and Computers.

Keywords: Males

Article reviews males' computer advantages in terms of training, role models, amount and type of computer uses, software, culture, and careers.

---. "How Adolescent Boys and Girls View Today's Computer Culture." National Educational Computing Conference. New Orleans, 2004.

Keywords: Use patterns, Attitudes and expectations, Middle school

A university professor and a teacher team-taught a social science unit to 250 7th and 8th graders, with students receiving 8 to 10 hours of instruction in a computer lab where there was one computer per student. Students and parents were surveyed before the start; focus groups were held at the end with students. Girls saw the computers as multi-use tools and as more multi-dimensional than boys, who saw them as machines, toys, or high-tech calculators. Girls saw the computer (in

descending order) as a tool for communication, productivity, and multi-purpose; for boys it was a machine for entertainment and gaming, for thinking, and for information. Males were more likely to take control of the mouse.

Christie, Alice A. "How Adolescent Boys and Girls View Today's Computer Culture." Meridian Middle School Computer Technologies Journal Winter 2005 (2005).

Keywords: Middle school, Culture

Adolescent girls and boys view and use computers differently, and each sex accepts this as natural. This was a yearlong qualitative study.

Christie, Alice Atkinson. "Using E-Mail within a Classroom Based on Feminist Pedagogy." Journal of Research on Computing in Education 30.2 (1997): 146-76.

Keywords: Pedagogy, Telecommunications, Classroom interactions, Elementary/primary

Elementary school children were observed for six months using email and other telecommunications. Findings: both girls and boys used telecommunications to confirm and to defy gender stereotypes, and that biased interactions in the classroom tended to be hard to see and hard to eliminate. "A feminist perspective informed the analysis."

Clarke, V., and J. Teague. "The Rationale, Development, and Evaluation of a Video to Encourage Girls to Study Computing." GASAT 7 International Conference (Gender and Science and Technology). Canada, 1993.

Could not obtain: not reviewed.

Clarke, Valerie A. "Computing in a Social Context." World Conference on Computers in Education. Eds. K. Duncan and D. Harris. Norfolk, Virginia: Elsevier Science Publishers B.V., North Holland, 1985. 833-38. Vol. Computers in Education.

Keywords: Attitudes and expectations, Outside U.S. Single-sex environment

Girls from coed and single-sex Australian schools were compared about their attitudes to computers. Girls at the single-sex school were less stereotyped than at the coed school. Younger girls were less stereotyped than older ones.

---. "Gender-Based Factors in Computing Enrollments and Achievement: Evidence from a Study of Tertiary Students." Journal of Educational Computing Research 5.4 (1989): 409-29.

Keywords: Postsecondary/tertiary, Outside U.S., Role models and mentors, Experience, Attitudes and expectations, Parents and home

A survey of first-year college students in Australia found that women had less prior computer experience and less positive attitudes toward computers, and had lower intention to pursue further computer study.

---. "Sex Differences in Computing Participation: Concerns, Extent, Reasons and Strategies." Australian Journal of Education 34.1 (1990): 52-66.

Keywords: Research review, Experience, Programming, Games, Parents and home, Stereotypes and bias, Enrollments, Applications, Use patterns, Attitudes and expectations, Software, Single-sex environment

Review of factors resulting in unequal computer science participation. Has Australian data as well as other. See keywords.

---. "Strategies for Involving Girls in Computer Science." In Search of Gender-Free Paradigms for Computer Science Education. Eds. C. Dianne Martin and Eric Murchie-Beyma. Eugene, OR: International Society of Technology Education, 1992. 71-85.

Keywords: Barriers, School programs

13 barriers to girls' enrollment and how to address them

Clarke, Valerie A., and Joy Teague. "Characterizations of Computing Careers: Students and Professionals Disagree." Computers in Education 26.4 (1996): 241-46.

Keywords: Career factors, Outside U.S.

Interviews were held with Australian male and female students in a university computer science program, high school students, and women working in CS jobs. Students at both levels held stereotyped views of computing and computer-related careers, in contrast to those of the women in CS jobs.

Clayton, Debbie, and Teresa Lynch. "Ten Years of Strategies to Increase Participation of Women in Computing Programs: The Central Queensland University Experience, 1999-2001." SIGCSE Bulletin 34.2 (2002): 89-93.

Keywords: Interventions, Secondary/high school, Postsecondary/tertiary, Enrollments, Single-sex environment

Presents interventions at the pre-tertiary level: careers information pack, bridging computing course, and visits to secondary schools and for girls to university. Interventions at the tertiary level: staff development, workshops for women about to graduate to overcome their tendency to undervalue their skills and abilities, and research on female attrition in distance education. Originally the focus was exclusively on women but it added student-wide activities because of hostility toward the program from staff and students, including women students, who did not like to draw attention to themselves as a gender group. The program disbanded from lack of funding, despite increased female CS enrollments.

Clayton, D. et al. "Strategies to Increase Female Participation in Computing Courses." Networking in the 90's: The Second Women in Computing Conference. Victoria University, Melbourne, Australia, 1993.

Could not obtain: not reviewed.

Clegg, Sue. "Disciplinary Discourse: A Case Study of Gender in Information Technology and Design Courses." Gender and Education 11.1 (1999): 43-55.

Keywords: Culture

Entering students in design and information technology were interviewed. Technical competency was seen as male. (Reviewed abstract only)

Clegg, Sue, and Deborah Trayhurn. "Gender and Computing: Not the Same Old Problem." British Educational Research Journal 26.1 (2000): 75-89.

Keywords: Culture, Attitudes and expectations, Outside U.S., Postsecondary/tertiary

Interviews were held with university information technology students in the UK. Women's contribution to computing is often ignored because they are seen as end users, not part of the academic mainstream. Both men and women were aware of gender differences in computing practice, but both expressed intrinsic as well as instrumental reasons for studying computers and both were confident in their abilities. Many women had had valuable administrative experience in using computer systems. A challenge is to conceptualize women's computer skills as real computing, and ask what is wrong with computing rather than what is wrong with women.

Cockburn, C., and S. Ormrod. Gender and Technology in the Making. London: Sage, 1993.

Could not obtain: not reviewed.

Cohoon, J. McGrath. "Departmental Differences Can Point the Way to Improving Female Retention in Computer Science." SIGCSE Technical Symposium on Computer Science Education. New Orleans, 1999.

Keywords: Retention, Postsecondary/tertiary, Departmental change

A study of Virginia computer science departments found that female students were most likely to leave before graduating from departments with higher-than-average attrition rates for both males and females. Departments with average attrition rates (= 12% to 25%) were more likely to lose males.

---. "Recruiting and Retaining Women in Undergraduate Computing Majors." SIGCSE Bulletin 34.2 (2002): 48-52.

Keywords: Retention, Recruitment, Enrollments, Interventions, Role models and mentors, Support groups, Departmental change, Postsecondary/tertiary

Paper presents methods for increasing female participation in undergraduate computer science. 1) Recruitment: work with high school teachers and guidance counselors, use role models, make contacts with local community colleges and community, recruit from inside university, reconsider selection criteria for impact on women, offer multiple points of entry, review public information for the image it projects. 2) Retention: maintain a stable faculty, provide role models, employ faculty who enjoy teaching undergrads, promote interaction among classmates (learning communities, peer support), mentor undergrads, communicate positive opinion of female students' strengths to them, involve women in research.

---. "Toward Improving Female Retention in the Computer Science Major." Communications of the ACM 44.5 (2001): 108-14.

Keywords: Teachers and faculty, Retention, Critical mass, Postsecondary/tertiary, Role models and mentors, Departmental change

Beautiful study of computer science departments throughout Virginia to determine what factors led to higher female retention. The most important was a critical mass of female students. Other factors included positive faculty characteristics and practices (low faculty turnover, positive attitudes toward women students, time spent mentoring women students, enjoying teaching, and presence of female faculty), high institutional support (undefined), and presence of CS jobs in the area. CS

departments in more selective institutions were not more likely to have better retention than those in less selective institutions.

---. "Women in Cs and Biology." SIGCSE Technical Symposium on Computer Science Education. Northern Kentucky University, 2002.

Keywords: Teachers and faculty, Retention, Postsecondary/tertiary, Departmental change

A comparison of attrition rates and factors in computer science and biology departments in Virginia colleges and universities found that compared to biology departments, CS had fewer women in the faculty, more faculty turnover, and faculty were less likely to think that women were well suited to their major. CS faculty spent less time mentoring students (although they mentored a higher percentage of women students), and were slightly less likely to believe that they shared responsibility for student success.

Cole, Anne, Tom Conlon, Sylvia Jackson, and Dorothy Welch. "Information Technology and Gender: Problems and Proposals." Gender and Education 6.1 (1994): 77-85.

Keywords: Culture, Access, Teachers and faculty, Research review, Language and terminology

Article examines research in 6 areas: access to the curriculum course design, teachers' attitudes and teaching styles, language (male-oriented and violent), assessment (types of tests), and the role of technology (male, overemphasis).

College Entrance Examination Board. Advanced Placement Summary Reports: 2003, 2003.

Keywords: Enrollments, Advanced Placement

In 2003, girls were 16% of those who took the one-semester Computer Science A exam, and 10% of those who took the two-semester Computer Science AB exam.

---. 2004 College-Bound Seniors: A Profile of Sat Program Test-Takers. New York: Author, 2004.

Keywords: Use patterns, Career factors,

Course-taking patterns of college-bound seniors are almost completely unchanged from 4 years ago, except that the percentage of boys saying they have taken no computer courses declined from 43% to 40% and the percentage of girls saying so rose from 57% to 60%. Of the students who say they intend to major in computer science in college, 88% are male.

Colley, Ann. "Gender Differences in Adolescents' Perceptions of the Best and Worst Aspects of Computing at School." Computers in Human Behavior 19.6 (2003): 673-82.

Keywords: Attitudes and expectations, Use patterns, Access, Outside U.S., Secondary/high school

Students in the UK toward the beginning and end of secondary school were asked about computing in school. Gender differences were found in both groups. Girls reported a greater work orientation and liking for email, while boys reported games and frustration with limited access to school computers. Conclusion: "[G]irls approach computers as tools for accomplishing tasks, while boys approach them as technology for play and mastery." (Reviewed abstract only)

Colley, Ann, Fiona Hill, Justin Hill, and Anna Jones. "Gender Effects in the Stereotyping of Those with Different Kinds of Computing Experience." Journal of Educational Computing Research 12.1 (1995): 19-27.

Keywords: Experience, Stereotypes and bias, Programming, Applications, Games, Outside U.S., Postsecondary/tertiary

The study investigated British college students' stereotypes of male and female "target figures" with experience in programming, word processing, or games. Few differences were found between the male and female target figures, and the pattern of ratings was similar for the three computer uses. However, stereotyping of the three uses differed according to the sex of the target figure, with females rating figures with programming experience higher than males did on autonomy and congeniality.

Colley, Ann M., Matthew T. Gale, and Teri A. Harris. "Effects of Gender Role Identity and Experience on Computer Attitude Components." Journal of Educational Computing Research 10.2 (1994): 129-37.

Keywords: Attitudes and expectations, Parents and home

144 entering university students were studied. Males were found to have lower computer anxiety, higher confidence, and greater liking than females. However, when the effects of prior experience and gender stereotyping were removed, no significant sex differences on the three measures remained. For both sexes, home computer use was associated with lower anxiety; for males it was also associated with higher confidence and for females with greater liking. Family members: both males and females were more positive about computers if they had a brother who used computers. The influence of the father's use was positive only for males, while the influence of the

mother's use was positive only for females. Females scoring high-masculine in the Bem Sex Role Inventory had more positive computer attitudes.

Collins-Jarvis, Lori. "Discriminatory Messages and Gendered Power Relations in on-Line Discussion Groups." National Communication Association. Chicago, 1997.

Could not obtain: not reviewed.

Collis, Betty. "Adolescent Females and Computers: Real and Perceived Barriers." Women and Education. Eds. J. Gaskell and A. McLaren. Calgary, Alberta: Detselig Enterprises, Ltd., 1988. 117-31.

Keywords: Access, Barriers, Attitudes and expectations, Extracurricular programs, Use patterns
Reviews barriers to equal computer use: school-related, social expectations, and personal.

---. "Psychosocial Implications of Sex Differences in Attitudes Towards Computers: Results of a Survey." International Journal of Women's Studies 8.3 (1985): 207-13.

Keywords: Attitudes and expectations, Outside U.S. ,Secondary/high school
3000 high school students in Canada were surveyed about computer attitudes. "Sex differences toward computers were found to be strongly established." Females were more stereotyped than males. Their perceptions are described as the "We Can But I Can't" paradox.

---. "Sex Differences in Secondary School Students' Attitudes toward Computers." The Computing Teacher (1985).

Keywords: Attitudes and expectations
Same study as Collis 1985, "Psychosocial ..."

---. "Sex Differences in the Association between Secondary School Students' Attitudes toward Mathematics and toward Computers." Journal for Research in Mathematics Education 18.5 (1987): 394-402.

Keywords: Attitudes and expectations, Mathematics, Outside U.S.
Attitudes toward math and computers were studied among 8th and 12th graders in Canada. Girls were more likely than boys to associate negative attitudes toward math with negative attitudes toward computers. Participation in an 8th grade math course that involved computers resulted in a positive attitude toward computers for boys but not for girls.

---. "Sex-Related Differences in Attitudes toward Computers: Implications for Counselors." The School Counselor 32.2 (1985): 120-30.

Keywords: Experience, Use patterns, Games, Parents and home, Attitudes and expectations, Interventions, Mathematics, Methodology, Outside U.S., Secondary/high school
Development of a validated instrument on computer attitudes for secondary students, administered to 887 8th and 12th boys and girls in British Columbia. Largest sex differences found in the mathematics-computer association. Significant sex differences were found for game playing and other uses of home computers. Computer users were viewed stereotypically by both boys and girls. Girls' attitudes toward computers were less positive except for those about female computer users: "We can but I can't" paradox.

Collis, Betty, Heidi Kass, Thomas Kieren, Denis Therrien, and Peter Wood. "Gender Differences in Canadian Grade 11 Students." Trans. 1988 June 5. Canadian Society for Studies in Education. Windsor, Ontario, 1988.

Keywords: Attitudes and expectations, Use patterns, Access, Parents and home, Outside U.S., Secondary/high school
"A nationwide survey of over 3,000 grade 11 students representing major urban areas in all ten provinces yielded data to support significant gender differences in access to and usage of computers in each of three usage categories: recreational, non-recreational home usage, and school."

Collis, Betty, and Lloyd Ollila. "The Effect of Computer Use on Grade 1 Children's Gender Stereotypes About Reading, Writing, and Computer Use." Journal of Research and Development in Education 24.1 (1990): 14-20.

Keywords: Attitudes and expectations, Elementary/primary, Outside U.S.
120 first-grade children in Victoria, B.C. were studied. Computer use was seen as a masculine activity, regardless of daily participation with computers.

Collis, Betty A., and Richard L. Williams. "Cross-Cultural Comparison of Gender Differences in Adolescents' Attitudes toward Computers and Selected School Subjects." Journal of Educational Research 81.1 (1987): 17-27.

Keywords: Cross-cultural, Attitudes and expectations, Age, Outside U.S., Secondary/high school
8th and 12th graders in Victoria, British Columbia and Shangai, People's Republic of China, were surveyed. Boys in both countries but especially in China were significantly more positive than girls about attitudes toward math and computers, the impact of computers on society, and self-

confidence in computer work. Girls in both countries showed a decline in attitudes toward math, science, and computers between grades 8 and 12, though Chinese girls in grade 12 were more positive than their Canadian counterparts. Girls in both countries believed that females have as much ability as males in science and technology; boys in both countries but especially Chinese boys were more skeptical.

Comber, Chris, Ann Colley, David J. Hargreaves, and Lisa Dorn. "The Effects of Age, Gender, and Computer Experience Upon Computer Attitudes." Educational Research 39.2 (1997): 123-33.

Keywords: Experience, Attitudes and expectations, Parents and home,

Survey of kids ages 11-12 and 15-16 found that males had more computer experience and more positive attitudes than females, but the gender differences were less for the younger kids. Males reported more home computer use than females, but controlling for this both sexes reported similar levels of computer enjoyment.

Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development. Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering, and Technology. National Science Foundation, 2000.

Keywords: Postsecondary/tertiary, Access

Recommendations for expanding access and retention: access to higher education, public image, nationwide accountability.

Cook, John, Carole Leathwood, and Peter Oriogun. "Online Conferencing with Multimedia Students: Monitoring Gender Participation and Promoting Critical Debate." Higher Education Academy, Center for Information and Computer Sciences. London, 2001.

Keywords: Distance education, Telecommunications, Aggression, Postsecondary/tertiary Outside U.S.

Postsecondary students in England taking an online course on Communicating via Multimedia were studied. Women read more posts than men; men posted more items than women. Women were underrepresented in students who passed the course and over-represented in those who failed it. The only hostile messages were posted by men; women ignored them or were conciliatory about them.

Cooper, Joel, and Joan Hall. Use with Caution: The Consequences of Sex-Biased Software. Unpublished manuscript. Princeton University, Princeton, NJ.

Keywords: Software, Context, Attitudes and expectations, Middle school,

"Software for elementary classrooms is slanted toward male preferences and symbols." 52 middle-school kids were given math software with violent or verbal themes, and computers were placed in a public computer room and private computer stations. Girls who used the violent software ("cross-gender software") had more anxiety and even more so when they were doing so in a public area where they could be seen. High anxiety affected performance on math scores negatively.

Cooper, Joel, Joan Hall, and Charles W. Huff. "Situational Stress as a Consequence of Sex Stereotyped Software." Personality and Social Psychology Bulletin 16 (1990): 419-29.

Keywords: Software, Stereotype threat, Context

Men and women were asked to do the same computer task either in public or in private. Some were told it would be easy and others that it would be difficult. No gender differences occurred when the task was done in private or in public, but there were differences based on expectation: men and women expecting success performed better in public than in private, while men and women expecting failure performed worse in public than in private. (Cited in Huff, 2002)

Cooper, Joel, and Jeff Stone. "Gender, Computer-Assisted Learning, and Anxiety: With a Little Help from a Friend." Journal of Educational Computing Research 15.1 (1996): 67-91.

Keywords: Attitudes and expectations, Single-sex environment, Experience, Use patterns, Stereotypes and bias, Context

80 students ages 10-15 recruited via a newspaper ad in central NJ used a tutorial program about edible/non-edible mushrooms in same- and mixed-sex groups and with and without a tutor present. Students first filled out a computer experience questionnaire (this raises stereotype threat questions to me), did the tutorial, then filled out a computer anxiety scale. Initial experience questionnaire: in same-sex groups girls indicated about the same hours/week than boys, but in mixed-sex groups girls reported significantly fewer hours/week as boys. Boys followed the same pattern: higher reported use in mixed-sex groups, lower in same-sex groups. Therefore, "self-reports of computer experience may have been inflated by boys, or deflated by girls, when they

participated in groups with students of the opposite sex." (p. 77) "[I]n the presence of boys, girls showed more stereotyped responding [sic] to computer usage before they began the science tutorial. That is, girls appeared to underestimate their knowledge and computer experience, they were less likely to explore the computer while setting up their desktop, and were more likely to ascribe a male gender to the computer [via a male or female face on the screen] when they participated in groups with boys. When girls participated with other girls, however, they did not act as reticent ... This suggests that gender differences in computer use may be a function of the classroom context." (p. 88)

Cooper, Joel, and Kimberlee D. Weaver. Gender and Computers: Understanding the Digital Divide. Mahwah, N.J.: Lawrence Erlbaum Associates, Inc., 2003.

Keywords: Attitudes and expectations, Teachers and faculty, Parents and home, Single-sex environment, Research review

Research review chapters on computer anxiety, the social context of computing, expectancies (self-fulfilling prophecies and attributions), stereotype threat, solutions (for parents, teachers, and teacher training), and single-sex schools and classrooms.

Corston, Rod, and Andrew M. Colman. "Gender and Social Facilitation Effects on Computer Competence and Attitudes toward Computers." Journal of Educational Computing Research 14.2 (1996): 171-83.

Keywords: Attitudes and expectations, Context

72 males and females ages 15-52 were given a computer-based task to do. "Females performed very much better in the presence of a female audience than alone or with a male audience." "The main conclusion of this study ... is that [it is] women's anxiety about computers and consequent lack of confidence that lies at the root of their generally inferior performance at tasks involving computers." (p. 181)

Council of Chief State School Officers. "A Concern About Computer Equity." Concerns 12 (1984): 1-4.

Keywords: Race, ethnicity, or SES, Access

Overview of early issues

Countryman, Jeri, Linda Kekelis, Alegra Feldman, and Ellen Spertus. "Developing a Hardware and Programming Curriculum for Middle School Girls." SIGCSE Bulletin 34.2 (2002): 44-47.

Keywords: Interventions, Curriculum, Extracurricular programs, Single-sex environment

Paper describes Techbridge, a three-year program that served about 200 middle- and high-school girls every year in a once-a-week after-school program. The curriculum contained hardware (opening computers and replacing floppy drives) and programming (LOGO and Stagecast, which is a visual programming language for creating animations for games or simulations). The single-sex environment was important to the girls.

Craig, Annemieke, Julie Fisher, Angela Scollary, and Mohini Singh. "Closing the Gap: Women Education and Information Technology Courses in Australia." Journal of Systems Software 40.1 (1998): 7-15.

Keywords: Interventions, Postsecondary/tertiary, Role models and mentors, Outreach, Extracurricular programs, Secondary/high school, Curriculum, Retention, Career factors, Enrollments, Single-sex environment

Article reports on various initiatives to promote, support, and retain female computing students at the postsecondary level in Australia. Nationwide, the Women in Computing group was established in 1991 to exchange information. One university introduced a bridge course. Once prior computer experience was held constant, single-sex and coed environments did not differ in how positive attitudes toward computers were.

Craig, Dorothy Valcarcel. "A League of Their Own: Gender Practices among Adolescents and Teachers in a Technology-Enhanced Learning Environment." Journal of Educational Technology systems 28.4 (1999): 349-63.

Keywords: Extracurricular programs, Single-sex environment, Telecommunications, Interventions

In a two-week summer computer camp for girls, it was found that in this single-sex environment girls displayed similar behaviors as male students do when engaging in technology-enhanced activities. (Abstract only)

Creamer, Elizabeth G., Carol J. Burger, and Peggy S. Meszaros. "Characteristics of High School and College Women Interested in Information Technology." Journal of Women and Minorities in Science and Engineering 10.1 (2004): 67-78.

Keywords: Career factors, Secondary/high school, Postsecondary/tertiary, Use patterns, Adults, Attitudes and expectations

Contrary to prior research, findings from a questionnaire completed by 436 high school, college and community college students did not reveal significant differences by gender in amount of computer use of most types of computer applications. However, men were more interested in IT careers than women but were more likely than women to have negative stereotypes about IT workers. Women who were interested in computers had more positive attitudes toward IT workers than women less interested. A challenge is how to encourage young women who enjoy computers to think of them in career terms.

Crombie, Gail, and Patrick Ian Armstrong. "Effects of Classroom Gender Composition on Adolescents' Computer-Related Attitudes and Future Intentions." Journal of Educational Computing Research 20.4 (1999): 317-27.

Keywords: Single-sex environment, Secondary/high school

An 11th grade computer science class was taught in three sections (one all-female and two mixed-sex) by the same male teacher. Girls could choose their section. Girls in the all-female class reported greater perceived teacher support than either males or girls in the mixed-sex classes, and were similar to males in confidence, motivation, and future academic intentions. The two mixed-sex classes were 19:5 and 19:3 M/F.

Crowley, Kevin. "Parent Differences During Museum Visits: Gender Differences in How Children Hear Informal Science." Visitor Studies Today 3.3 (2000): 21-28.

Keywords: Parents and home, Preschool, Stereotypes and bias, Classroom interactions

While not directly concerned with computing, intriguing nevertheless. In a study of family groups visiting science museums, it was found that both parents but especially fathers explained the science content of interactive science exhibits to sons three times more than to daughters, and this was true for children as young as 1 year old. In contrast, parents at interactive music exhibits were twice as likely to explain the exhibits to daughters than to sons. "A casual observer in the museum on a day we collected data would probably have noticed no differences in the ways that parents spoke to boys or girls. Parents brought their daughters to a museum, engaged interactive science exhibits with them, talked about what to do with exhibits, and talked about what to perceive from exhibits. It was only when we analyzed the videotaped records of these interactions that we detected that the crucial educational step of providing an explanatory context for the experience was primarily reserved for boys." (p. 23)

Culley, L. Gender Differences and Computing in Secondary Schools. Longborough, UK: Longborough Department of Education, Longborough University of Technology, 1986.

Could not obtain: not reviewed.

Culley, Lorraine. "Gender Equity and Computing in Secondary Schools: Issues and Strategies for Teachers." Computers into Classrooms: More Questions Than Answers. Eds. J. Beynon and H. Mackay. London: Falmer Press, 1993. 147-59.

Could not obtain: not reviewed.

---. "Girls, Boys and Computers." Educational Studies 14.1 (1988): 3-8.

Keywords: Teachers and faculty, Stereotypes and bias, Programming

Teachers regarded 11- and 12-year-old boys as more interested in computing and rewarding to teach than girls. Even when it was observed that girls did everything that was asked of them and presented good work, they were still seen by some teachers as having less of a flair for programming. (As cited in Sutton [1991])

---. "Option Choice and Careers Guidance: Gender and Computing in Secondary Schools." British Journal of Guidance and Counseling 16.1 (1998): 73-82.

Keywords: Barriers, Career factors, Parents and home, Teachers and faculty, Media, Mathematics, Peers and friends. , Stereotypes and bias, Outside U.S., Secondary/high school

Six secondary schools in England were studied. Computer courses were optional. Scheduling: In several schools, the computer course was offered at the same time as traditionally female courses (either/or). Because computer resources were limited it was necessary for students to compete for places and this might reduce girls' chances of taking a computer course. Math: Many of the schools linked the course to math ability (many of the computer teachers also taught math and most were male), a disincentive for girls. Some schools enrolled students on a first-come, first-served basis, favoring the more enthusiastic: boys. Twice as many boys as girls had home computers. Career aspirations: a survey of nearly 1,000 students showed a clear division along gender-stereotyped lines. None of the 330 girls who had not opted for a computer course showed any interest in a computer-related career, and even for those who had, a computer career ranked

4th at 8% (vs. boys, for whom it ranked first). Girls were aware that technology was required in many careers, but did not see a computer course as essential. Counselors and teachers expressed a commitment to equal opportunity but felt it was their duty to be "neutral" in advising students. They saw the source of gender stereotypes as outside school: parents, peers, and media. Most career literature was gender-biased.

Cuny, Janice, and William Aspray. "Recruitment and Retention of Women Graduate Students in Computer Science and Engineering: Results of a Workshop." Computing Research Association. San Francisco, 2000.

Keywords: Postsecondary learning & achievement,Pipeline

Recommendations for increasing the recruitment and retention of women in graduate IT programs. Good.

Cuny, Janice E. "Workshops Offer Mentoring Opportunities." Computing Research News (1995).

Keywords: Role models and mentors, Interventions, Postsecondary/tertiary

Workshops for beginning computer science graduate students are held before major conferences with senior women in CS providing advice on academic careers, thus serving as mentors.

Currell, Wendy. "Sex Differences in Preschool Children's Computer Play." Fifth World Conference on Computers in Education. Sydney, Australia, 1990.

Keywords: Age, Preschool, Outside U.S.

In a study of 55 preschool children in Australia, boys' computer time far exceeded that of girls in free-play time, although girls' time at the computer increased over time while that of boys decreased. Perhaps the novelty effect was wearing off for boys and perhaps girls were gradually gaining confidence.

Dain, Julia. "Getting Women into Computing." University Computing 10 (1988): 154-57.

Keywords: Interventions, Extracurricular programs, Outside U.S.

A one-week residential course was held for 6th-form girls in the UK. About a third of the girls expressed an intention to change their planned major to computer science.

---. "Women and Computing: Some Responses to Falling Numbers in Higher Education." Women's Studies International Forum 14.3 (1991): 217-25.

Keywords: Postsecondary/tertiary, Culture, Interventions, Curriculum, Mathematics, Outside U.S.

The article analyzes the drop in female participation in computing courses in higher education in the UK. It corresponds to a change to the mathematization of the syllabus in contrast with the linguistic approach of earlier years, the mechanistic view of computing, and the absence of discussion of social, political, ethical, and legal issues. Responses include "taster" courses for schoolgirls and the establishment of a national coordinating body for Women in Computing.

Damarin, Suzanne K. "Rethinking Equity: An Imperative for Educational Computing." The Computing Teacher 16 (1989): 16-18.

Could not obtain: not reviewed.

Dambrot, Faye H., Michelle A. Watkins-Malek, S. Marc; Marshall Silling, Rodney S., and Jo Ann Garver. "Correlates of Sex Differences in Attitudes toward and Involvement with Computers." Journal of Vocational Behavior 27 (1985): 71-86.

Keywords: Attitudes and expectations, Experience, Mathematics, Postsecondary/tertiary,

In a survey of university freshmen in a psychology class, small but significant differences were found. Females held more negative computer attitudes, scored lower in computer aptitude, had less prerequisite math ability and math course work, had completed fewer computer-related courses, and were less likely to know a computer language. Computer aptitude was strongly related to math ability and math experience. Computer attitude was related to math anxiety and computer experience. "In the area of mathematics, a body of literature has tied math anxiety to avoidance of mathematics course work ... Similar dynamics may be operating to explain, in part, the greater number of males enrolled in computer classes and involved with computers." (p. 83)

D'Amico, Miranda, Lois J. Baron, and Mary Elizabeth Sissons. "Gender Differences in Attributions About Microcomputer Learning in Elementary School." Sex Roles: A Journal of Research 33.5/6 (1995): 353-85.

Keywords: Context, Attitudes and expectations, Outside U.S., Elementary/primary

About 220 Canadian 5th and 6th graders did a drill-and-practice program (Word Attack), randomly assigned to groups of 1, 2, or 4 (no attention to sex composition of groups) and randomly assigned .5, 1.0, and 1.5 hours of computer time. A year later the study was repeated with different 5th and 6th graders using the Analogies Tutorial. For girls but not for boys, attributed luck was an important predictor of performance. Increased exposure time in the first study increased mastery

of the task for girls but not for boys; it made no difference for either in the second study. Boys did better in groups of two but girls did better in groups of 4.

Davidson, Ann Locke, and Janet Ward Schofield. "Female Voices in Virtual Reality: Drawing Young Girls into an Online World." Building Virtual Communities: Learning and Change in Cyberspace. Eds. K. Ann Renninger and Wesley Shumar. Cambridge, UK: Cambridge University Press, 2002. 34-59.

Keywords: Telecommunications, Attitudes and expectations, Elementary/primary

8 female and 2 male third-graders participated in a MOO (Multiuser Object Oriented), an online text-based environment over the course of a year. Girls improved in interest level, attitude, and perceptions of confidence with respect to computers.

Davidson-Shivers, G. et al. "Gender Differences: Are They Diminished in Online Discussions?" International Journal on E-Learning 2.1 (2003): 29-36.

Keywords: Distance education, Telecommunications

A graduate web-based course was monitored to examine how male and female students participated in online discussions. Gender differences in substantive and non-substantive statements were small and diminished over four weeks in both chats and threaded discussion. (Reviewed abstract only)

Davies, A.R., M. Klawe, M. Ng, C. Nyhus, and H. Sullivan. "Gender Issues in Computer Science Education." Fifth Annual NISE Forum. Detroit, 2000.

Keywords: Research review, Career factors, Software, Programming, Outreach, Adults, Role models and mentors, Games, Access, Experience, Elementary/primary, Programming, Attitudes and expectations, Culture, Interventions, Secondary/high school

Review of literature on gender and software, role models, access, experience, attitudes. Cites Koch et al. about computer in-groups (usually male) and out-groups (usually female) in elementary school and includes 7 points that must be addressed to reduce computer gender gaps. They report a survey of HS students on interest in school subjects, career choices, computer use in school and at home, and perceived computer proficiency. They also report on a project to involve children in grades 4-8 in educational computer games (the age when many children lose interest in math and science). They report on Virtual Family, a program created to allow children to program in Java with girl-friendly content. They report on various outreach activities to girls (classroom visits, workshops). Last they report on ARC (Alternate Routes to Computing), a career-change program for adults with bachelors degrees with special attention to females; problems and successes with ARC are noted.

Davies, Vanessa, and Tracy Camp. "Where Have Women Gone and Will They Be Returning: Predictions of Female Involvement in Computing." CPSR Newsletter 18.1 (2000).

Keywords: Pipeline

Prediction of a large decline in the number of women with computer science degrees in the early 2000s.

Denner, Jill, and Linda Werner. "The Girls Creating Games Program: Strategies for Engaging Middle-School Girls in Information Technology." Frontiers: A Journal of Women Studies 26.1 (2005).

Keywords: Middle school, Role models and mentors, Games

Four strategies were tried with 62 middle-school girls in an afterschool program and a summer camp: design an interactive computer game in Flash, pair programming, challenging stereotypes about who likes computers, and carrying out identity formation activities. No findings.

DeRemer, Mary. "The Computer Gender Gap in Elementary School." Computers in the Schools 6.3/4 (1990): 39-49.

Keywords: Attitudes and expectations, Elementary/primary

92 third and sixth graders took an attitude questionnaire. Girls scored significantly higher in computer liking at both grade levels, inconsistent with secondary level findings. Boys and girls had similar levels of confidence in their ability to learn with and about computers. Boys saw computers as a male domain but girls did not.

Dickhauser, Oliver. "Gender Differences in the Choice of Computer Courses: Applying an Expectancy-Value Model." Social Psychology of Education 6.3 (2003): 173-89.

Keywords: Parents and home, Enrollments, Attitudes and expectations, Outside U.S.

In two studies of children ages 10-16 in Germany, it was found that boys took computer courses more frequently than girls at the early high school level. It was found that computer course choice correlated with the value placed on computers and the expectation of success, and partly on perceived parental attitudes. (Abstract only)

Dorman, Steve M. "Technology and the Gender Gap." Journal of School Health 68.4 (1998): 165-66.
Keywords: Teacher education, Role models and mentors, Parents and home
Ways to achieve gender equity in the classroom.

Dougherty, Barbara, and Linda Heal. Computer Access: Key to Success. A Report on Factors Influencing Wisconsin Technical College Students' Enrollment in Computer Information Systems Programs. Madison, WI: Center on Education and Work, School of Education, 1999.
Keywords: Parents and home, Experience, Mathematics
1,831 students in nine Wisconsin technical colleges who were expecting computer science degrees returned surveys. Females were less likely to have had computer experience prior to enrolling, especially having a computer at home in high school, and took less math in high school.

Drash, Wayne. "All Girl, All Tech: Nationwide Program Offers Girls-Only Computer Training." CNN.com July 11, 2000 2000.
Keywords: Extracurricular programs, Role models and mentors, Single-sex environment
Description of eight all-girls summer computer camps across the country.

Dryburgh, Heather. "Underrepresentation of Girls and Women in Computer Science: Classification of 1990s Research." Journal of Educational Computing Research 23.2 (2000): 181-202.
Keywords: Role models and mentors, Experience, Culture, Single-sex environment, Elementary/primary, Secondary/high school, Postsecondary/tertiary, Software, Curriculum, Attitudes and expectations, Research review
A review of research in the 1990s on women's declining participation in computer science finds that most research is done at the postsecondary level and with non-randomly selected subjects. At the elementary school level research focuses on structural factors, but by the postsecondary level it is more likely to focus on social-psychological factors. Lack of role models is emphasized at the elementary and secondary levels, less so at postsecondary. Culture is a factor at the postsecondary level. Single-sex is a factor at all three levels. Excellent review.

Dugdale, Sharon, Elyon DeKoven, and Mi-Kyung Ju. "Computer Course Enrollment, Home Computer Access, and Gender: Relationships to High School Students' Success with Computer Spreadsheet Use for Problem Solving in Pre-Algebra." Journal of Educational Computing Research 18.1 (1998): 49-62.
Keywords: Parents and home, Access, Mathematics, Secondary/high school
50 9th graders were studied for the effects of home computer access and computer course enrollment on mathematically weak students' ability to use a spreadsheet as a learning resource in a pre-algebra course. Home computer access was related to initial success for females, and the advantages of computer course enrollment was dramatically greater for those girls who had a computer at home compared to girls who did not. Enrollment in a school computer course did not appear to increase the math performance much of girls who did not have a home computer, whereas it did, and substantially, for boys. "[T]he results of this study suggest that home computer access may be more important for female students than for males." (p. 59)

Durndell, A. "Choice and Image: Gender and Computer Studies in Higher Education." Women in Computing: Selected Papers, 1988-1990. Eds. G. Lovegrove and B. Segal. London: Springer-Verlag, 1991. 152-60.
Could not obtain: not reviewed.

---. "The Persistence of the Gender Gap in Computing." Computers and Education 16.4 (1991): 283-87.
Keywords: Use patterns, Experience, Stereotypes and bias, Postsecondary/tertiary, Outside U.S.
Entering university students in 1986 and 1989 were studied. While both males and females in the latter group increased in terms of computer knowledge and reported more computer use, the gender gap in favor of males persisted. A factor commonly mentioned by students of both sexes for not choosing computer studies was the negative image of an isolated person sitting at a terminal all day.

Durndell, Alan. "Why Do Female Students Tend to Avoid Computer Studies?" Research in Science & Technological Education 8.2 (1990): 163-70.
Keywords: Career factors, Culture, Experience, Attitudes and expectations, Outside U.S., Postsecondary/tertiary
210 business and science college students in the UK were surveyed about why they chose not to study computing. Computing had a bad image as a career and a subject of study. Both sexes but especially females wanted to work with humans, not in isolation with machines. Females did not ascribe importance to male domination of computing. Experience with computers in school was either less for females than males and/or more negative.

Durndell, A., C. Cameron, A. Knox, and R. Stocks. "Gender and Computing: West and East Europe." Computers in Human Behavior 13.2 (1997): 269-80.

Keywords: Attitudes and expectations, Parents and home, Stereotypes and bias, Cross-cultural, Outside U.S.

Many countries under Communism produced many female technologists at a time when many western countries were not doing so. Comparable groups of university students in Romania and Scotland were surveyed. In a second study, questionnaires were given out to Romanian psychology students and their parents. Parents had more stereotyped attitudes than students, both male and female. Romanians, females and males, had less experience but were far more positive about computers than Scottish students. Females in Romania, as opposed to Scotland, find it "quite unexceptional for females to be interested in technology." (p. 279)

Durndell, Alan, Peter Glissov, and Gerda Siann. "Gender and Computing: Persisting Differences." Educational Research 37.3 (1995): 219-27.

Keywords: Experience, Attitudes and expectations, Parents and home, Secondary/high school, Outside U.S.

429 secondary students were studied. Girls had less computer experience, were less likely to own computers, had a less positive orientation to computers, and held less gender-stereotypical views than boys. Younger girls reported more enthusiasm for computers than older girls. There was no gender difference in game-playing and using word processing out of school.

Durndell, A., Zsolt Haag, and Heather Laithwaite. "Computer Self-Efficacy and Gender: A Cross-Cultural Study of Scotland and Romania." Personality and Individual Differences 28.6 (2000): 1037-44.

Keywords: Attitudes and expectations, Cross-cultural, Outside U.S.

Males in both Scotland and Romania had higher self-efficacy ratings for their computer skills, especially at the advanced level and for software skills. Ratings were more similar for beginning skills.

Durndell, A., and P. Lightbody. "Gender and Computing: Change over Time?" Computers in Education 21.4 (1993): 331-36.

Keywords: Use patterns, Attitudes and expectations, Parents and home, Career factors, Secondary/high school, Outside U.S.

16-18 year olds in the UK were studied in 1986, 1989, and 1993. There was little change in students' attitudes, use patterns, knowledge of IT and desire to study IT over that time, with males showing more time with computers and knowledge of IT.

Durndell, Alan, Gerda Siann, and Peter Glissov. "Gender Differences and Computing in Course Choice at Entry into Higher Education." British Educational Research Journal 16.2 (1990): 149-62.

Keywords: Career factors, Stereotypes and bias, Teachers and faculty, Role models and mentors, Critical mass, Culture, Aggression, Outside U.S., Postsecondary/tertiary

387 entering college students in Scotland were surveyed about reasons for choosing their intended majors, why they think there are few women in computing, and how those numbers could be increased. A male interviewer also interviewed 37 male and female students of computing. There was a broad consensus that the fault lay with tradition, society's expectations, stereotyping, and conditioning, that girls had to be encouraged starting early in school, and that more female teachers and role models would help. Only female students spoke of not wanting to deal with the male-oriented culture created by male computer staff and the nearly all-male student groups — "the harassment of continually bumping into male egos." (p. 159) Both males and females agreed that boys in school tended to talk about computers and girls did not. Women intending to go into computing, unlike other women, were more interested in the extrinsic rewards of attraction of the jobs and the pay, like the males intending to go into computing.

Durndell, A., and K. Thomson. "Gender and Computing: A Decade of Change?" Computers and Education 28.1 (1997): 1-9.

Keywords: Parents and home, Peers and friends, Stereotypes and bias, Use patterns, Attitudes and expectations, Outside U.S., Secondary/high school

16- to 18-year-old students in the UK were studied in 1986, 1989, 1992, and 1995. By 1995 school use had become equal but home use and use of a friend's computer (social use) remained primarily male. Computer knowledge had increased for both sexes but males retained the advantage. A negative stereotype about computer users remained constant among those choosing not to use computers. Females continued to be more likely to believe they did not have computer skills. The

data thus suggest "a mixture of change and stability over time. ... [T]here is some slight, but only slight, indication that the size of the differences might be declining." (p. 6) "[A]n equalization of performance is a long way off. A crude extrapolation of the data presented here would put this far into the next century." (p. 7) Conclusion: "[I]n Britain the last decade has produced some slight change in the relative interest and involvement with computing of females as opposed to males, but that this has been of a very limited form." (p. 8)

Durndell, A. et al. "A Survey of Attitudes to, Knowledge About, and Experience of Computers." Computing Education 11 (1987): 167-75.

Could not obtain: not reviewed.

Dyck, Jennifer L., and Janan Al-Awar Smither. "Age Differences in Computer Anxiety: The Role of Computer Experience, Gender and Education." Journal of Educational Computing Research 10.3 (1994): 239-48.

Keywords: Attitudes and expectations, Adults, Age

Younger adults (30 and younger) and older adults (55 and older) in educational programs who volunteered to participate were compared on computer experience and attitude measures. For both age groups and for males and females, people had less anxiety when they had more experience. There were no gender differences for either group on computer attitude, anxiety, or confidence. Younger females were less likely to express liking than younger males; for the older group there was no gender difference.

Eastman, Caroline M. "Accommodating Diversity in Computer Science Education." Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics and Engineering. Ed. Sue V. Rosser. New York: Teachers College Press, 1995. 160-68.

Keywords: Race, ethnicity, or low SES, Curriculum, Barriers, Programming, Role models and mentors

Discusses barriers to enrollment and retention in terms of gender, race, ethnic background and national origin, personal and career goals, language ability, physical ability, and sexual orientation.

Eastman, Susan Tyler, and Kathy Krendl. "Computers and Gender: Differential Effects of Electronic Search on Students' Achievement and Attitudes." Journal of Research and Development in Education 20.3 (1987): 41-48.

Keywords: Early work, Attitudes and expectations, Experience, Stereotypes and bias, Middle school

Before using computers, 8th grade girls held less rigid stereotypes and more positive attitudes about females' potential computer abilities than boys. Afterwards, the attitude gap between boys and girls diminished. Conclusion: experience using computer reduces gender stereotypes.

Eccles, Jacquelynne. Why Women Shy Away from Careers in Science and Math. 2005. Available: http://www.umich.edu/news/index.html?releases/2005/Apr05/r040705c. July 8, 2005.

Keywords: Context, Culture, Parents and home

Girls avoid careers in science, math and technology because they believe these careers are socially isolating. Parents undermine their daughters' self-confidence.

Edwards, Carol. "Implications of the Computer Culture for Women of Color." In Search of Gender-Free Paradigms for Computer Science Education. Ed. C. Dianne & Murchie-Beyma Martin, Eric. Eugene, OR: International Society for Technology in Education, 1992. 57-68.

Keywords: Race, ethnicity, or SES

How the computer culture discourages people of color.

Edwards, P.N. "The Army and the Microworld: Computers and the Politics of Gender Identity." Signs: Journal of Women in Culture and Society 16.1 (1990): 102-07.

Keywords:

Could not obtain: not reviewed.

Eisenberg, Rebecca L. "The Barbie Syndrome: Computer Software Developers Nurture Sexist Stereotypes." Examiner May 22, 1997 1997.

Keywords: Software, Elementary/primary, Stereotypes and bias

Software aimed at girls is based on well-established cultural gender-role stereotypes.

Elkjaer, Bente. "Girls and Information Technology in Denmark: An Account of a Socially Constructed Problem." Gender and Education 4.1/2 (1992): 25-40.

Keywords: Culture, Stereotypes and bias, Outside U.S.

Masculinity, not femininity, is a problem in the computer classroom because boys retreat into the computer and avoid having "to compete with other boys to secure their position in the hierarchy." Boys consider themselves hosts and girls, guests.

ENWISE. Enwise Report, 2004.

Keywords: Cross-cultural

A report on the status of women in science and technology in 15 European countries and 15 other countries. Communist regimes advanced women's participation in science and technology by means of establishing equal rights to education and employment, availability of childcare, and state support of working mothers. The post-communist transition has resulted in a sharp decline of funds allocated to science and technology, a decrease in the research population, and the disappearance of military and associated industries, which have impacted more on women than men.

e-skills UK. Computer Clubs for Girls. n.d. Available: http://www.e-skills.com/cgi-bin/wms.pl/33. November 29, 2004.

Keywords: Extracurricular programs, Middle school, Outside U.S.

A program of computer clubs for girls in the UK was run by schools for girls aged 10-13. There are now 109 clubs in SE England; more than 3,600 girls have participated. 62% of them said the experience made them more likely to enter a technology-related career.

Etzkowitz, Henry, Carol Kemelgor, Michael Neuschatz, and Brian Uzzi. "Restructurturing Departments for Equity." In Search of Gender Free Paradigms for Computer Science Education. Eds. C. Dianne Martin and Eric Murchie-Beyma. Eugene, OR: International Society for Technology in Education, 1992.

Keywords: Departmental change, Role models and mentors, Critical mass

Women in CS believe the lack of viable role models contributes to the rate of attrition. Departments must accomodate the contradiction between the biological clock and the tenure clock for women. A critical mass of female faculty and grad students will reduce barriers and negative male attitudes, improve the culture, and increase the success rate of women achieving tenure and degrees.

Ferguson-Pabst, Donna, Kay Persichitte, Linda Lohr, and Betsy Pearman. "An Analysis of the Influence of Gender, Grade Level, and Teacher on the Selection of Mathematics Software by Intermediate Students." Information Technology in Childhood Education Annual 2003.1 (2003): 5-27.

Keywords: Software, Elementary/primary

Upper-elementary students were asked to choose among 4 pieces of math software. There were no gender differences in selection (or grade level) but there were significant differences in time-on-task by both factors, with boys spending more time on task than girls on all software choices.

Fetler, Mark. "Sex Differences on the California Statewide Assessment of Computer Literacy." Sex Roles: A Journal of Research 13.3/4 (1985): 181-91.

Keywords: Experience, Attitudes and expectations, Early work

A 1982-83 statewide survey of 6th and 12th graders in computer science and computer literacy found that boys in both grades displayed higher levels of achievement in nearly all curriculum objectives surveyed. Boys had more exposure to computers at school and at home, and tended to have more positive attitudes toward the role of computers in the workplace.

Fiore, Catherine. "Awakening the Tech Bug in Girls." Learning & Leading with Technology 26.5 (1999): 10-16.

Keywords: Software, Role models and mentors, Teachers and faculty, Pedagogy, Games

Girls have "qualitatively different expectations and satisfactions from today's computer games" than boys. The 10 most important design and content issues are: low frustration levels, story lines that appeal to girls, celebration of girls, collaboration rather than competition, challenging and complex activities, exploration and lack of closure, graphics, rich and reality-based visuals and audio, personal exploration, and interactive communication. The article also contains 18 suggestions for teachers.

Fish, Marian, Alan Gross, and Jo Shuchat Sanders. "The Effect of Equity Strategies on Girls' Computer Usage in School." Computers in Human Behavior 2 (1986): 127-34.

Keywords: Use patterns, Teachers and faculty, Interventions, Middle school

Teachers in five middle schools were given a workshop on computer equity for girls. In three schools, teachers were also provided with intervention strategies, from which they chose several to implement. Students' computer usage records indicated that girls' computer use rose significantly in the schools where interventions had been carried out. Simply presenting computer equity

information to teachers did not result in a change in girls' computer behavior. "This is the first empirical evidence that interventions targeted at girls can increase voluntary computer usage." (pp. 132-133)

Fisher, Allan, and Jane Margolis. "Unlocking the Clubhouse: The Carnegie Mellon Experience." SIGCSE Bulletin 34.2 (2002): 79-83.

Keywords: Attitudes and expectations, Experience, Teachers and faculty, Retention

Summarizes findings reported in more detail in their book of the same name: different motivations to study computer science, women's lower pre-college computing experience but this is not a predictor of success, male culture of CS ("geek mythology"), and the lockstep relationship of confidence and interest. Summary of changes to curriculum and culture: multiple entry points, computing in context, closing the experience gap, more attention to good teaching, providing support to women by helping them become aware of confidence issues. Results: from 1995 to 1999 female enrollment increased from 7% to 42% and persistence increased from about 40% to about 90%, now on a par with men.

Fisher, Allan, Jane Margolis, and Faye Miller. "Undergraduate Women in Computer Science: Experience, Motivation and Culture." SIGCSE Technical Symposium. San Jose CA, 1997.

Keywords: Experience, Attitudes and expectations, Culture, Parents and home, Career factors, Programming, Classroom interactions, Postsecondary/tertiary, Teachers and faculty

Students think computer science = programming. Though it's not true, it discourages them.

---. Why Women Study (or Don't Study) Computer Science. Rec. Summer 1998.

Keywords: Retention, Postsecondary/tertiary, Experience

Powerpoint presentation at seminar for CS teachers at Carnegie Mellon University, Summer 1998, on research conducted at CMU's School of Computer Science on women's under-enrollment and factors that increase it. They found that although women had less prior computing experience than men, this did not matter for the international women. They increased the points of entry into the program and made other changes, with an enrollment increase from 5% in 1991 to 42% in 1999.

Fitzpatrick, Helen, and Margaret Hardman. "Mediated Activity in the Primary Classroom: Girls, Boys and Computers." Learning and Instruction 10 (2000): 431-46.

Keywords: Single-sex environment, Context, Outside U.S., Elementary/primary, Language and terminology

120 seven- and nine-year-olds in the UK worked on a language-based task on and off the computer, and in same-sex and mixed-sex pairs. There was a high degree of collaboration in both male and female pairs, in contrast to earlier studies. At both ages and on and off the computer, mixed-sex pairs were were more assertive than same-sex pairs. Collaboration tended to break down more readily in mixed-sex pairs; when this happened boys on the computer task were more dominant while girls tended to give up, and girls on the non-computer task were more dominant. In same-sex pairs children were equally assertive.

Fletcher-Flinn, Claire M., and Thomas Suddendorf. "Computer Attitudes, Gender and Exploratory Behavior: A Developmental Study." Journal of Educational Computing Research 15.4 (1996): 369-92.

Keywords: Attitudes and expectations, Elementary/primary, Secondary/high school, Experience, Stereotypes and bias, Preschool, Outside U.S.

Three studies were conducted in New Zealand.

Study 1. 40 3- and 4-year-olds were interviewed about computer knowledge and gender attitudes then introduced to the computer for an interactive story, "Just Grandma and Me." There were no gender differences in exploratory behavior or computer knowledge, but there were significant attitude differences: boys thought the computers were used by males, but girls thought either both males and females or girls. Experience on the computer did not change these gender-stereotypical patterns.

Study 2. 81 12-year-old high school students completed computer questionnaires. Males were more likely than females to believe in male computer primacy, but they were less gender-stereotyped than the preschool boys in Study 1.

Study 3. 40 15-year-old high school students were asked to complete a computer program about Vietnam, then to fill out a questionnaire. Computer attitudes were still somewhat male-identified.

Forgasz, Helen. "Girls, Boys and Computers for Mathematics Learning." Mathematical Association of Victoria. Victoria, Australia, 2003.

Keywords: Mathematics, Attitudes and expectations, Outside U.S.

Questionnaires were given to about 2,600 students and about 100 teachers in grades 7-11 in Victoria (Australia) co-ed schools, and classroom observations and interviews were held with some students and teachers. Teachers believed that computer-competent students stood to gain most from computer use in mathematics learning, and they saw boys as more competent with the computer.

Forsyth, Alfred S. Jr., and David F. Lancy. "Girls and Microcomputers: A Hopeful Finding Regarding Software." Computers in the Schools 6.3/4 (1989): 51-59.

Keywords: Software, Attitudes and expectations, Elementary/primary, Games

120 fourth and fifth graders played a computer game, "Winnie the Pooh in the Hundred-Acre Wood," in which students had to use a map and recognize various locations, requiring visual/spatial acuity and geography skills, both of which have been shown to favor boys. Girls liked and learned from it to the same extent as boys, possibly because of a lack of male orientation and lack of violence.

Francioni, Joan. "Committee on the Status of Women in Computing Research." Computing Research News (1998).

Keywords: Interventions, Postsecondary/tertiary

Overview of activities of CRA-W, established to conduct activities for the purpose of increasing the number of women in computer science and engineering research and education, increase women's success, and provide a forum for addressing problems that women experience. They published a booklet on CS careers for women, established a mentoring project, set up a collaborative research experience for undergraduate women, enabled young women to attend professional conferences, prepared a kit of information for graduate women, gave workshops on academic careers for graduate women, prepared a database of Ph.D.-level women, and wrote a column ("Expanding the Pipeline") every month in the Computing Research News.

Francioni, Joan M. "A Conference's Impact on Undergraduate Female Students." SIGCSE Bulletin 34.2 (2002): 66-69.

Keywords: Support groups, Role models and mentors, Interventions, Attitudes and expectations, Postsecondary/tertiary

Author took 7 female undergraduate computer science majors to a Grace Hopper conference. They felt the experience was positive for role-model value, support for their efforts, and motivation to persist. 18 months later they felt even more that it had been a positive experience in that they had by then experienced some of the things they learned about at the conference. Some of them said that the conference helped them to gain confidence (they realized that their skills were in fact as good as those of their male classmates), that it helped them to become activists on behalf of other women in CS, and that it helped them feel part of a community.

Francis, Leslie J. "The Relationship between Computer-Related Attitudes and Gender Stereotyping of Computer Use." Computers and Education 22.4 (1994): 283-89.

Keywords: Attitudes and expectations, Outside U.S., Postsecondary/tertiary

378 undergraduate students in Wales completed questionnaires about computer attitude and gender stereotypes about computers. No sex differences were found on computer attitudes, and only a small minority of students held gender-stereotyped views of computer use. The suspicion that the opposite sex was better at computer use and a less positive attitude towards computers was associated with greater computer anxiety for both females and males.

Francis, Leslie J., Jaacov Julian Katz, and Thomas E. Evans. "The Relationship between Personality and Attitudes Towards Computers: An Investigation among Female Undergraduate Students in Israel." British Educational Research Journal 27.3 (1996): 164-70.

Keywords: Attitudes and expectations, Outside U.S., Teacher education

298 female teacher education students were given computer attitude and personality tests. Introverts have a more positive attitude than extroverts (= sociable, likes to take chances). High psychoticism scorers (= cold, impersonal, hostile, lacking in sympathy, etc.) have a more positive attitude than low scorers. There was no relationship between neuroticism (= worrier) and attitude towards computers. "One of the major problems in interpreting the discrepant findings from previous research [about computer attitudes] concerns the variety of instruments employed to assess computer-related attitudes. " [T]here is considerable variation within the constructs being measured."

Freedman, Kerry. "Microcomputers and the Dynamics of Image Making and Social Life in Three Art Classrooms." Journal of Research on Computing in Education 21 (1989): 290-98.

Keywords: Use patterns, Experience, Graphics, Elementary/primary, Classroom interactions

5th grade (and high school) art classes were observed and interviewed about doing computer graphics. 0.5% of the 5th grade girls and 24.5% of the boys said they had taught themselves how to use a computer. In interviews, two reasons for the discrepancy emerged: boys initiated their own computer experiences and girls rarely did, and boys got more attention from adults in learning how to use computers. The girls focused more on interactions with each other than with the computer; for the boys it was the reverse. Girls seemed to be more interested in color and the relational elements of an image than boys, and less interested in movement. In mixed-sex groups, at first boys ignored girls and girls did not participate in activity or decisions. With time, girls began to participate by focusing on what boys first chose to focus on.

Freeman, Catherine E. Trends in Educational Equity of Girls & Women: 2004. Washington DC: National Center of Education Statistics, U.S. Department of Education, 2004.

Keywords: Pipeline, Use patterns, Experience, Race, ethnicity, or SES

Elementary and secondary girls and boys were equally likely to use the computer at school and home in 2001, and racial/ethnic group did not make the results different. Computer use for both sexes rose since 1993, when they were also mostly equal by sex. (p. 38)

Frieze, Carol, and Lenore Blum. "Building an Effective Computer Science Student Organization: The Carnegie Mellon *Women@Scs* Action Plan." SIGCSE Bulletin 34.2 (2002): 74-78.

Keywords: Support groups, Role models and mentors, Postsecondary/tertiary

Plan for forming a support group for women in computer science, based on the Women@SCS group at Carnegie Mellon. Recommends these essentials: having a core group of activist students at the helm, faculty and institutional support, a program coordinator, regular meetings with agendas, elect council leaders, web site, meet in a comfortable room and not a classroom, distribute announcements to all women, get funding from the highest possible level for credibility, and use the group to provide input to the school. Also presented are many activities such a group can sponsor: professional and/or mentoring, conferences and outreach, and social activities.

Furger, Roberta. Does Jane Compute? Preserving Our Daughters' Place in the Cyber Revolution. New York: Warner Books, 1998.

Keywords: Parents and home, Attitudes and expectations, Learning & achievement, elementary - high school

Popular book about home and school gender gap in computing.

Gabbert, Paula, and Paige H. Meeker. "Support Communities for Women in Computing." SIGCSE Bulletin 34.2 (2002): 62-65.

Keywords: Support groups, Interventions, Role models and mentors, Teacher education, Cross-cultural, Outside U.S.

Describes activities provided by the support communities available for women in computing at the ACM-W (ACM Committee on Women in Computing), CRA-W (Committee on the Status of Women in Computing), IWT (Institute for Women and Technology / Anita Borg Institute), and various professional associations (WIC, Women into Computing UK; AWC, Association for Women in Computing; and WITI, Women in Technology International). Activities include mentoring and role models, providing career information to girls, providing workshops on gender issues to teachers, research sponsorship, policy studies, conference sponsorships (Grace Hopper), listservs (Systers), etc.

Galpin, Vashti. "Women in Computing around the World." SIGCSE Bulletin 34.2 (2002): 94-100.

Keywords: Cross-cultural, Research review, Outside U.S.

Superb review of the factors involved in female participation in computing worldwide, and data on the percentage of women in undergraduate CS in Africa (10 countries), Asia and Australasia (9 countries), Europe (12 countries), and North and South America (6 countries). Conclusions about the factors involved: lots of differences and no consistent pattern. "[T]hese research results do not show a clear pattern that can help to explain why the differences between men and women with respect to computing occur in some countries and cultures, and not in others." (p. 95) Data: Across these 37 countries, women's participation generally ranges between 10% and 40%, with some lower and some (Malasia, Singapore, and Thailand) a little over 50%.

Galpin, Vashti, Ian Sanders, Heather Turner, and Bernadine Venter. Computer Self-Efficacy, Gender, and Educational Background in South Africa.

Keywords: Attitudes and expectations, Single-sex environment, Retention, Outside U.S. Secondary/high school, Postsecondary/tertiary, Age

In a study of 14- and 15-year-old students in Johannesburg, females' self-efficacy score was slightly higher than that of males. The median score was significantly lower for girls at co-ed schools than single-sex schools. Many more of the boys planned to continue with computer studies than girls. In a study at the university level, females scored significantly lower in self-efficacy than males. Female students predicted receiving lower grades than males, whereas in reality the actual grades were quite similar. Female self-efficacy with computers appeared to decrease with age.

Gardner, J.R., A. McEwen, and C.A. Curry. "A Sample Survey of Attitudes to Computer Studies." Computers and Education 10.2 (1986): 293-98.

Keywords: Attitudes and expectations, Single-sex environment, Outside U.S.

1500 6th-form students in Northern Ireland were surveyed. More boys than girls saw computing as essential to their futures. Although the majority of girls disagreed, girls in coed schools were more likely to agree that boys were better at computers than girls in single-sex schools: "Girls in co-educational schools are more likely to be influenced by gender stereotypes in their attitudes to computers than their counterparts in single-sex schools." (p. 297)

Gaston, Barbara. "Steps (Science, Technology, and Engineering Preview Summer Camp): A Tuition Free Technology and Science Summer Camp for Girls." Techdirections 60.9 (2001): 20-23.

Keywords: Extracurricular programs, Interventions, Curriculum, Telecommunications, Middle school, Secondary/high school

Weeklong residential camp for middle and high school girls. Curriculum includes CADD and website design.

Gatta, Mary. Women and Work: Prospects for Parity in the New Economy. New Brunswick, NJ: Center for Women and Work, Rutgers University, 2001.

Keywords: Secondary/high school, Postsecondary/tertiary, Role models and mentors, Software, Classroom interactions, Career factors, Retention, Parents and home, Teachers and faculty

New Jersey study, a report to the State Employment and Training Commission's Council on Gender Parity in Labor and Education. Reasons for female under-representation at the high school level: lack of teacher training in technology; differential treatment based on gender; subtle discouragement from parents, teachers, and counselors; sexual and gender harassment; male-oriented educational and recreational software; female isolation in technology classrooms. Reasons for female under-representation at the college level: academic environment not friendly towards women, lack of female mentors, women's lack of awareness of career options due to lack of role models, greater female attrition from major.

Gerver, E. "Computers and Gender." Computers in the Human Context. Ed. T. Foster. Cambridge, MA: MIT Press, 1989.

Could not obtain: not reviewed.

Gilbert, Lucia Albino, Melinda J. Bravo, and Lisa K. Kearney. "Partnering with Teachers to Educate Girls in the New Computer Age." Journal of Women and Minorities in Science and Engineering 10.2 (2004): 179-202.

Keywords: Stereotypes and bias, Middle school, Teacher education, Attitudes and expectations

Two studies were done with 7th grade students and their math teachers on computers and gender. In the first, teachers were given a one-day gender equity workshop and a random half were then provided with a grad student to give them help and resources with gender equity; the grad student kept in touch with them too. This was ineffective: teachers "reported that the day-to-day activities of their classrooms were too time-consuming to allow time to use the assistance of the resource person." Students were given skits to act out and a collaborative group activity to do, and this too was not successful. In the second study, teachers observed researchers piloting a new skit and attended two two-hour seminars on gender equity, as "partners" with the researchers. Students this time got two skits and two collaborative group projects. There was a control group for the kids. Results: Girls in the treatment group reported greater interest in future computer and technology involvement and less endorsement of boys' computer expertise than girls in the control group on a pre/post design. Teachers anecdotally said consciousness-raising things about their participation (p. 194 ff).

Girl Scouts. Girls Go Tech. n.d. Available: http://www.girlsgotech.org. Retrieved November 29, 2004.
Keywords: Career factors, Parents and home
Website for girls on technology careers, with a page for parents.

Girl Scouts Hornets' Nest Council. Girls Are I.T. n.d. Available: http://www.girlsareit.org. Retrieved November 19, 2004.
Keywords: Career factors, Website for girls
Website for girls on technology careers, inventions, and uses.

Glass, C.R., and L.A. Knight. "Cognitive Factors in Computer Anxiety." Cognitive Therapy and Research 12?4 (1988): 351-66.
Could not obtain: not reviewed.

Glissov, P. et al. "Chips with Everything: Personal Attributes of Heavy Computer Users." Educational Studies 20.3 (1994): 376-77.
Could not obtain: not reviewed.

Goode, Joanna, Rachel Estrella, and Jane Margolis. "Lost in Translation: Gender and High School Computer Science." Women and Information Technology: Research on the Reasons for under-Representation. Eds. William Aspray and J. McGrath Cohoon. Cambridge MA: MIT Press, 2006.
Keywords: Programming, Secondary/high school, Career factors, Barriers, Race, ethnicity, or SES, Experience, Games, Parents and home, Pedagogy, Curriculum, Attitudes and expectations
In three years of interviews and observations in three southern California high schools with students, faculty, administrators, and staff, it was found that in schools serving lower-income students of color the computer classes were primarily low level and vocationally oriented. In schools that offered more advanced courses, many girls opted out beyond the introductory level because they feared that competing with tech-savvy boys, primarily white and Asian, would hurt their academic records and harm their college prospects. In all the high schools, CS as taught was focused on basic skills and not problem-solving, which was uninteresting to college-bound females. Most girls had no image of a computer scientist and cited the media as their information source. They did not realize how CS could be relevant to their intended careers. Female high achievers often did not have room in their schedules for another course. Boys had more computer experience and classroom dominance because of games designed for adolescent males, and they learned programming syntax more easily from this context. Girls in programming had male relatives in a technical job. Many girls objected to computing as isolated and unsocial.

Goodfellow, Kris. "The Games People Play." New York Times July 22 1996.
Keywords: Games
Article about the maleness of computer games, from survey of over 2,000 visitors to a game web site. Most were male but women favored different games from men's.

Grant, W. Vance, and Thomas D. Snyder. Digest of Education Statistics, 1985-86. Washington DC: U.S. Department of Education, Center for Statistics, 1986.
See title.

Graves, D., and M. Klawe. "Supporting Learners in a Remote Computer-Supported Collaborative Learning Environment: The Importance of Task and Communication." Computer Support for Collaborative Learning. Toronto, 1999.
Could not obtain: not reviewed.

Gressard, Clarice P., and Brenda H. Loyd. "An Investigation of the Effects of Math Anxiety and Sex on Computer Attitude." School Science and Mathematics 87.2 (1987): 125-35.
Keywords: Attitudes and expectations, Experience, Mathematics
Students in junior high, high school, community college, and college were surveyed about computer anxiety, confidence and liking. Computer experience corresponded with positive attitudes and math anxiety corresponded to negative attitudes for both males and females. Sex of student did not affect the results.

Griffiths, Morwenna, and Margaret Alfrey. "A Stereotype in the Making: Girls and Computers in Primary Schools." Educational Review 41.1 (1989): 73-79.
Keywords: Stereotypes and bias, Outside U.S., Elementary/primary
Despite equal attitudes of teachers to computers in school as indicated by several surveys, children in primary school in England are likely to be affected by the stereotype because of the early association of computers with males, because of higher male use patterns and because of the association between computers and maths and science. In addition, responsibility for computers

is often attached to high positions in schools (such as head or deputy) and these are likelier to be male. "We are witnessing a stereotype in the making." (p. 77)

Groundwater-Smith, S. and K. Crawford. "Computer Literacy and Matters of Equality." Journal of Information Technology for Teacher Education 1.2 (1992): 215-29.

Could not obtain: not reviewed.

Grundy, Frances. "Computer Software: A Clue to De-Gendering Technology?" The Nature of Gender - The Gender of Nature. Kiel, Germany, 2000.

Keywords: Software, Culture

Hardware and software are male preserves and discourage women from enrolling in and persisting in CS courses.

Gunn, Cathy. "Dominant or Different? Gender Issues in Computer Supported Learning." Journal of Asynchronous Learning Networks 7.1 (2003): 14-30.

Keywords: Parents and home, Attitudes and expectations, Telecommunications, Use patterns, Access Context, Distance education, Outside U.S., Postsecondary/tertiary

A questionnaire was given to entering students at the University of Edinburgh over 10 years. Women were less likely to own their own computers. Women's confidence in their ability to use email and the Web increased more rapidly than men's but was still lower. Over the decade, sex differences in expectations of computer use have completely disappeared.

In a study at an English university of an online course with some in-person lectures, it was found that women had much more of a problem with access than males: they were far less likely to have ready access to a home computer because of lower priority in sharing it with others. Females were more likely to express apprehension about the online aspect. They were likelier to work later in the evening than males, fitting study time around family obligations. Final grades were about equal.

In a New Zealand university, students taking a web design course could choose a classroom or an online mode. Women performed better than men in the online mode, perhaps because of stronger motivation to succeed and greater ability to work independently and manage multi-tasking lives.

Gunn, C. et al. "Gender Issues in Computer-Supported Learning." Association for Learning Technology Journal 10.1 (2002): 32-44.

Could not obtain: not reviewed.

Gupta, Uma G., and Lynne E. Houtz. "High School Students' Perceptions of Information and Technology Skills and Careers." Journal of Industrial Technology 16.4 (2000): 2-8.

Keywords: Attitudes and expectations, Secondary/high school

In a survey of public, parochial, and private high school students in Nebraska, it was found that girls' interest in IT courses and careers was significantly lower than that of boys.

Gurer, Denise. "Pioneering Women in Computer Science." Communications of the ACM 38.1 (1995): 45-54.

Could not obtain: not reviewed.

Gurer, Denise, and Tracy Camp. "An ACM-W Literature Review on Women in Computing." ACM SIGCSE Bulletin 34.2 (2002): 121-27.

Keywords: Pipeline, Research review, Attitudes and expectations, Experience, Games, Role models and mentors, Context, Teachers and faculty, Parents and home, Single-sex environment, Access, Aggression, Outreach, Retention, Postsecondary/tertiary, Culture, Classroom interactions,

*A review of the literature in the keyword subjects. **Pipeline**. In computing, boys act as hosts and girls as guests, which results in girls unknowingly allowing the boys to gain more experience. (p. 121). With more experience, girls compete evenly with boys. **Attitudes**. Girls' computer attitudes become more negative as they get older. **Experience**. One problem is pre-requisite courses. When instructors learn that women have had less computer experience, they erroneously interpret lack of ability or interest. **Games**. Games are most children's first computer experiences, and they are gender-stereotyped, target boys, and exhibit gender biases. There is aggressive behavior in video arcades. **Role models**. Mentoring and role models help with recruiting and retention. **Self-confidence**. Professors of both sexes favor males in class, lowering female self-confidence, which is exacerbated by males' sexist attitudes. **Computing environments**. The male and sometimes hostile environment discourages women. **Societal influences**. Most images of CS are negative and imply it's for nerds or men, exacerbated by adolescent peer pressure. **Teacher and family encouragement**. Computer science teachers are often math teachers and favor male students, which creates a male culture in class. In homes, computers are often provided more for*

boys or their access is favored by parents. Mothers' negative attitude is not helpful. ***All-female environment****. Single-sex environments "can produce women with higher levels of confidence" (p. 123). Single-sex workshops, seminars, or lunches can also help.* ***Graduate school****. The pipeline shrinks dramatically from undergraduate to graduate school. CS college majors are often tired of coping with the negative environment and "vehemently decline the offer." (p. 123) Some have difficulty making the transition from being good students in college to the need for being strategic and independent in graduate school.* ***Balancing work and family****. Many CS school and work positions are not female-friendly, especially for young mothers.*

---. Investigating the Incredible Shrinking Pipeline for Women in Computer Science, 1998.

Keywords: Pipeline, Attitudes and expectations, Experience, Role models and mentors, Culture, Parents and home, Single-sex environment, Access, Media, Aggression, Language and terminology, Postsecondary/tertiary

Pipeline shrinkage is due to negative attitudes, lack of prior computer experience, misleading course prerequisites, games, lack of mentoring and role models, low self-confidence and perceived competence (despite good and sometimes superior performance), male-dominated computing environments, work/motherhood stresses, hostile language, lack of female companionship, lack of access to male-dominated study groups and computer clubs, lack of encouragement from family and teachers, lack of all-female environments, unequal access to computers, and negative media portrayals. They present recommendations to counter problems in each of these areas. Cites a study by M. Moroh & D. Sturm, presented at the National Educational Computing Consortium Conference in1995, that while women felt that men out-performed them in computing, women actually outperformed men.

---. "Women Role Models in Computer Science History." Computing Research News (1998).

Keywords: Role models and mentors

Describes the careers of several pioneering women in computer science for role model purposes.

Hackbarth, Steven L. "Changes in Primary Students' Computer Literacy as a Function of Classroom Use and Gender." TechTrends 45.4 (2001): 19-27.

Keywords: Elementary/primary, Access, Attitudes and expectations

Children in 3rd, 4th, and 5th grade classes in New York City schools displayed similar attitudes toward computers, senses of efficacy in using them, knowledge of computer terminology, and amount of classroom access.

Hafner, Katie. "Girl Games: Plenty and Pink." New York Times September 10, 1998 1998.

Keywords: Software, Games

Computer games for girls have finally arrived on the market, but they are gender-stereotyped.

---. "Girls Soak up Technology in Schools of Their Own." New York Times September 23, 1999 1999.

Keywords: Single-sex environment

Describes girls' single-sex education in several private schools, and how helpful this is for math, science and technology.

---. "What Is Little Girls' Software Made Of?" HomePC October 1994: 101-05.

Keywords: Software, Games

Games with strong stories and characters that appeal to girls may help remedy gender bias in computing.

Hakkarainen, Kai, and Tuire Palonen. "Patterns of Female and Male Students' Participation in Computer-Supported Learning." Computers and Education 40.4 (2003): 327-41.

Keywords: Pedagogy, Outside U.S.

In two grade 5-6 classes in Finland, male and female students reacted differently to the computer mode of instruction. Conclusion: "[U]se of new technology should be thoroughly subsumed under pedagogical goals in order to facilitate female students' participation in computer-supported learning." (Reviewed abstract only)

Haliburton, William et al. "Gender Differences in Personality Components of Computer Science Students: A Test of Hollands' Congruence Hypothesis." SIGSCE '98, 1998.

Could not obtain: not reviewed.

Hanor, Joan H. "Concepts and Strategies Learned from Girls' Interactions with Computers." Theory into Practice 37.1 (1998): 64-71.

Keywords: Elementary/primary, Access, Teacher education,

Examination of young girls' aesthetic experience with computers in interviews. Girls describe barriers to their access to computers.

Hanson, Katherine. Gender, Discourse and Technology. Newton, MA: Education Development Center, Inc.: Center for Equity and Cultural Diversity, 1997.

Keywords: Culture, Race, ethnicity, or SES, Classroom interactions, Games, Stereotypes

Overview of negative situation for girls in computer classrooms, with attention to games.

Hardy, V. "Computer Conferencing: A New Medium for Investigating Issues in Gender and Learning." Higher Education 28.3 (1994): 408-18.

Could not obtain: not reviewed.

Harrell, W. "Gender and Equity Issues Affecting Educational Computer Use." Equity and Excellence in Education 31.13 (1998): 46-48.

Could not obtain: not reviewed.

Harris, S. "Secondary School Students' Use of Computers at Home." British Journal of Educational Technology 30.4 (1999): 331-39.

Keywords: Parents and home, Access, Use patterns

There were significant gender differences in access to home computers, frequency of use, and applications used. (Reviewed abstract only)

Harvey, T.J., and B. Wilson. "Gender Differences in Attitudes Towards Microcomputers Shown by Primary and Secondary School Pupils." British Journal of Educational Technology 16.3 (1985): 183-87.

Keywords: Attitudes and expectations, Elementary/primary, Secondary/high school, Parents and home, Use patterns, Outside U.S.

Elementary and high school children in England were surveyed about their computer attitudes. There is a discrepancy by gender in home computer ownership (almost twice as many boys owned them). The authors surmise that parents more actively support their sons' interest in computers and tell daughters a computer is too expensive, which is what the researchers found girls saying on the survey. Overall, though, there was little sex difference and little elementary vs. secondary difference, but a large difference between owners and non-owners.

Hashim, Hajah Rugayah Hj., and Wan Narita Mustapha. "Attitudes toward Learning About and Working with Computers of Students at Uitm." Turkish Online Journal of Educational Technology 3.2 (2004): Article 1.

Keywords: Attitudes and expectations, Outside U.S.

300 undergraduate and graduate students at the University Technology Mara Shah Alam in Malaysia were surveyed about attitudes about computers. Women had a higher usefulness subscore than men.

Hassoun, Soha, and Soheila Bana. "Practices for Recruiting and Retaining Graduate Women Students in Computer Science and Engineering." IEEE Technology and Society Magazine (2001): 106-07.

Keywords: Postsecondary/tertiary, Outreach, Retention, Role models and mentors

Includes recommendations for better recruiting and retention in the areas of departmental atmosphere, role models, support groups, academic support, supporting first-year students, mentoring, and balancing study and family.

Hattie, John, and Donald Fitzgerald. "Sex Differences in Attitudes, Achievement, and Use of Computers." Australian Journal of Education 31.1 (1987): 3-26.

Keywords: Attitudes and expectations, Use patterns, Research review, Age

A meta-analysis of empirical studies found small sex differences in computer attitude and no achievement differences. In two studies of students, parents and teachers, the researchers found that as many males as females liked computers but many more girls "ardently disliked" computers (p. 3). There were no differences between elementary-age boys and girls in terms of computer use and attitudes, but differences became more marked as students progressed through secondary grades.

Hawkins, Jan. Computers and Girls: Rethinking the Issues. New York: Center for Children and Technology, Bank Street College of Education, 1984.

Keywords: Access, Curriculum, Attitudes and expectations, Use patterns, Programming, Software, Early work

A review of issues as understood in 1984.

Hearn, James C., and Susan Olzak. "The Role of College Major Departments in the Reproduction of Sexual Inequality." Sociology of Education 54.3 (1981): 195-205.

Keywords: Career factors, Enrollments, Role models and mentors, Retention, Teachers and faculty

College students in the US were surveyed about their choice of major. Males were more likely to choose unsupportive departments providing high status rewards, whereas women exhibited the opposite pattern. For women not making the standard choices, supportive interactions with individual faculty members appeared critical to their satisfaction levels.

Hearne, D.J., and B. Martin. "Computer Equity in Education." Educational Technology? (1989): 47-51.

Could not obtain: not reviewed.

Henwood, Flis. "Exceptional Women? Gender and Technology in U.K. Higher Education." IEEE Technology and Society Magazine 18.7 (1999): 21-27.

Keywords: Stereotypes and bias, Culture

A toy ad for technological toys is analyzed for gender-stereotyped messages about technology. A "liberal" interpretation of technology is that it is neutral: women and girls lack the skills and attitudes that men and boys have and need to catch up — the deficit model. In this account, neither technology nor gender is questioned. In contrast, a constructivist approach understands technology as a social and cultural construct, a reflection of social relations and cultural norms dominant in society as it exists. In a course for computer science majors, the few women saw themselves (and were seen by the men) as exceptional, "and therefore, by implication, different from the majority of women, who are thereby rendered incompetent and outsiders in technological culture." (p. 24) Seeing technical women as exceptional keeps women marginalized in technology. "[T]he task of changing the outcomes of women's education in computer technologies is more complicated than simply teaching them how to use computers. ... It is also necessary to change how the women (and the men around them) understand and talk about the presence and competence of women." (p. 25) In order to move beyond the dualism of male/female, skilled/incompetent, good/bad, we must understand how gender is constructed in technology.

Henwood, Flis, Sarah Plumeridge, and Linda Stepulevage. "A Tale of Two Cultures? Gender and Inequality in Computer Education." Technology and in/Equality: Questioning the Information Society. Eds. Sally Wyatt, Flis Henwood, Nod Miller and Peter Senker. London: Routledge, 2000. 111-28.

Keywords: Attitudes and expectations, Learning styles, Outside U.S.

A small (10) and partial sample of women in the UK taking a traditional computer science course and an interdisciplinary, contextual CS course were studied. Women in the traditional course did as well as the men in terms of percentage passing the course and average grade, while women in the interdisciplinary course were twice as likely as men to pass the course and got a significantly higher average grade on the exam. Nevertheless, both groups of women underestimated their computer competence relative to obvious evidence to the contrary and in relation to equally competent men. "Gender is thus constructed, in relation to technology and technical skills, in oppostional terms, so that the acquisition of technical skills by women is perceived by many as a threat to the masculinity of men and to gender order more generally." (pp. 114-115)

Herring, Susan, Anna Martinson, and Rebecca Scheckler. "Designing for Community: The Effects of Gender Representation in Videos on a Web Site." Hawaii International Conference on System Sciences: IEEE Computer Society Press, 2002. Vol. Proceedings of the 35th Hawai'i International Conference on System Sciences.

Keywords: Telecommunications, Teacher education, Stereotypes and bias

In a professional development web site for teachers, unintentional bias in the representation of gender in the videos was reflected in participation imbalances by males and females. The authors recommend taking gender into account in creating multimodal interfaces that represent humans directly.

Herring, Susan C. Gender and Participation in Computer-Mediated Linguistic Discourse, 1992. ERIC ED345552

Keywords: Telecommunications

The study examined patterns of participation in a linguistics listserv and found that women respond to adversarial exchanges by limiting their participation.

---. "Gender Differences in CMC: Findings and Implications." The CPSR Newsletter (Computer Professionals for Social Responsibility) 18.1 (2000).

Keywords: Telecommunications, Research review, Culture, Aggression

A research review of computer-mediated communication (CMC) starting with research on gender and CMC in the late 80s. Asynchronous communications tend to reproduce male dominance; synchronous communications tend to be more egalitarian, perhaps because they are more

anonymous with pseudonyms. Conclusions: Internet users "display features of culturally-learned gender styles in their typed messages, and ... gender differences ... work to the disadvantage of women, especially when they function as cues to attract predatory or harassing attention from men." Asynchronous environments "show greater inequity in terms of participation, while [synchronous environments] show greater objectification of women in sexual terms." The expectation that telecommunications would erase male/female inequality was naive, since it is imported from off-line environments. Excellent article.

---. The Rhetorical Dynamics of Gender Harassment on-Line, 1999. ERIC EJ599669

Keywords: Telecommunications

The study analyzed the gender dynamics of two on-line groups, one a chat channel and another an academic listserv, and found harassment of female participants by male participants.

Hess, Robert D., and Irene T. Miura. "Gender Differences in Enrollment in Computer Camps and Classes." Sex Roles: A Journal of Research 13 (1985): 193-203.

Keywords: Extracurricular programs, Programming, Parents and home, Race, ethnicity, or SES

23 directors of summer computer camps were surveyed. Findings: Three times as many boys as girls were enrolled. The ratio of males to females increased with grade, cost of program, and level of difficulty of course offerings. Enrollment was 98% upper-middle class and 91% White; Asian Americans were over-represented and other minorities under-represented.

Hickling-Hudson, Anne. "Rich Schools, Poor Schools, Boys and Girls: Computer Education in Australian Secondary Schools." Journal of Educational Policy 7.1 (1992): 1-21.

Keywords: Race, ethnicity, or SES, Parents and home, Use patterns, Outside U.S.

They visited 13 schools and surveyed and interviewed administrators, teachers, and Year 10 (15-16 years old, final compulsory school year) Australian students in high SES, middle SES, and low SES schools in Queensland, Australia. SES was defined by parents' educational levels and occupations. The computer resources (hardware, software, staff) of the high SES schools were much more extensive than the others'. Home computer ownership was highest for students whose fathers had a tertiary education and/or higher-status occupations; there was no difference for mothers. Boys used home computers more than girls for all purposes. Boys, especially those from high SES backgrounds, had more access to higher-order computer experiences (using computers for a purpose) at school. Girls in business courses have more access to lower-level computer uses (learning about the computer). Bottom line: students from well-off families, especially boys, had more access to and benefit from high levels of computer education than those from lower SES families and girls.

Higher Education Policy Institute. The American Freshman: National Norms for Fall 2000 — Executive Summary, 2001.

Keywords: Use patterns, Attitudes and expectations, Career factors, Programming

Use patterns are converging but women have less confidence in their computer skills than at any time in the history of the survey. They have far less interest in programming careers than males.

Hirt, Joan B., James H. Murray, and Janice K. McBee. "Technology and Diversity: An Impending Collision on the Information Superhighway?" NASPA Journal 38.1 (2000): 1-17.

Keywords: Telecommunications, Enrollments

Students who applied for admission to higher education institutions electronically were likelier to be male (87%) and white (92%). As electronic admission procedures increase, this may disfavor women.

Hodes, Carol L. "Gender Representations in Mathematics Software." Journal of Educational Technology Systems 24.1 (1995): 67-73.

Keywords: Software, Stereotypes and bias, Mathematics

In a review of elementary math software, only 12.5% of the programs that had main characters that were gender-identifiable featured females. Such bias can affect the attitudes and achievement of female students.

Holzberg, Carol S. "Computer Technology: It's a Girl Thing." Technology and Learning (1997): 42-48.

Keywords: Interventions, Postsecondary/tertiary, Secondary/high school, Curriculum, Pedagogy, Retention, Career factors, Telecommunications

A professor of computer science at Furman University in Greenville SC redesigned his introductory CS courses to make them more attractive to females. Project PipeLINK at Renssaeler Polytechnic Institute was a program to attract more women to CS. A high school teacher in Idaho runs a

"Young Women in Technology Program" in which girls are exposed to technology in the community. The Cybergrrl website was set up for girls.

Honey, Margaret, Babette Moeller, Cornelia Brunner, Peggy Clements Bennett, and Jan Hawkins. Girls and Design: Exploring the Question of Technological Imagination. New York: Center for Technology in Education, Bank Street College of Education, 1991.

Keywords: Curriculum, Pedagogy, Adults, Middle school, Culture

Twenty-four adult technology experts and 80 early adolescents were asked about their views of technology. Females saw technology as people connectors, communication, and collaboration devices. Males tended to see technology as extensions of their power over the physical universe.

Houle, Philip. "Toward Understanding Student Differences in a Computer Skills Course." Journal of Educational Computing Research 14.1 (1996): 25-48.

Keywords: Postsecondary/tertiary, Attitudes and expectations

The study involved 221 business administration students who were surveyed about computer anxiety, attitude, self-efficacy, and cognitive style. Gender was one of many demographic variables. Very little gender difference was found in the four measures except for self-efficacy which favored males.

Howell, Kathy. "The Experience of Women in Undergraduate Computer Science: What Does the Research Say?" SIGSCE Bulletin 25.2 (1993).

Could not obtain: not reviewed.

Hoyles, Celia. Girls and Computers. London: Institute of Education, University of London, 1988.

Could not obtain: not reviewed.

---. "Review of the Literature." Girls and Computers. Ed. Celia Hoyles. Vol. Bedford Way Papers 34. London: Institute of Education, University of London, 1988.

Keywords: Research review, Attitudes and expectations, Access, Media, Use patterns

Chapter reviews literature on attitudes about computers, public image of computers, and access to and use of computers in schools.

Hsi, Sherry, and Christopher M. Hoadley. "Productive Discussion in Science; Gender Equity through Electronic Discourse." Journal of Science Education and Technology 6.1 (1997): 23-36.

Keywords: Classroom interactions, Telecommunications

Students' discussion was studied in electronic and classroom modes. Females participated in electronic discussion more than males, and less than males in classroom discussion. Girls reported feeling less stifled in an electronic medium when anonymity was an option. (Reviewed abstract only)

Huang, Shwu-Yong L. "Education Students' Perceptions of Computers: A Cross-Cultural Study." Journal of Educational Computing Research 29.4 (2003): 451-69.

Keywords: Attitudes and expectations, Cross-cultural, Outside U.S.

360 education students in the U.S. and Taiwan were surveyed about their computer attitudes. Taiwanese students indicated significantly higher concerns about gender-related differences than their counterparts in the U.S. Females in both countries disagreed that males work better with computers than females; males in both countries were more likely to agree.

Huber, Brad R., and Richard Scaglion. "Gender Differences in Computer Education: A Costa Rican Case Study." Journal of Educational Computing Research 13.3 (1995): 271-304.

Keywords: Stereotypes and bias, Outside U.S., Use patterns, Teachers and faculty

Teachers in an elementary school in Costa Rica were studied. They allocated more of their time to boys than to girls. Boys monopolized the time and attention of the computer lab teachers, leaving the girls to seek help from the less knowledgeable classroom teachers.

Huber, Brad R., and Janet Ward Schofield. ""I Like Computers, but Many Girls Don't": Gender and the Sociocultural Context of Computing." Education/Technology/Power: Educational Computing as a Social Practice. Eds. Hank Bromley and Michael W. Apple. Albany: State University of New York Press, 1998. 103-31.

Keywords: Attitudes and expectations, Software, Programming, Stereotypes and bias, Parents and home, Research review, Elementary/primary, Outside U.S.

Review of research on computer attitudes (liking, confidence, and anxiety), software, programming (including differential assistance), stereotypes from teachers and students, and extracurricular

computer use. Chapter briefly describes 1990 work with elementary students in Costa Rica, who thought about and used computers differently according to gender.

Huff, Chuck. "Gender, Software Design, and Occupational Equity." SIGCSE Bulletin 34.2 (2002): 112-15.

Keywords: Software, Context, Stereotypes and bias, Teachers and faculty

Teachers, 80% female (many of whom had expressed concern about gender bias in software), were asked to design language arts software. Those who were asked to design software for boys designed games; those who were asked to design software for girls designed learning tools, and those who were asked to design software for students designed games exactly like software for boys. When children used software designed for the other gender, they experienced more "situational stress" than when they used same-gender software but only in a public setting, not in private. In view of the fact that changing gender-based expectations is difficult, software that reinforces traditional gender roles ("software for girls") "may give girls experiences of success with computers, but this benefit may be offset by the support it gives to traditional gender-based subjective task values." (p. 115)

Huff, Charles, and Joel Cooper. "Sex Bias in Educational Software: The Effect of Designers' Stereotypes on the Software They Design." Journal of Applied Social Psychology 17.6 (1987): 519-32.

Keywords: Software, Stereotypes and bias, Teachers and faculty

43 New Jersey educators from 1st grade through college with programming experience, 34 female and 9 male, were asked to design software for either boys, girls, or students. Programs for girls were classifiable as learning tools, whereas programs for boys and students were most like games. Boy/student programs required more eye-hand coordination, quicker reflexes, and contained more screen action than girl programs. The sex of the designer did not make a difference. "We conclude that it is not the computer, or even the software, that is at the root of the sex bias in software, but the expectations and stereotypes of the designers of the software." (p. 519)

Huff, Charles W., John H. Fleming, and Joel Cooper. "Gender Differences in Human-Computer Interaction." In Search of Gender-Free Paradigms for Computer Science Education. Eds. C. Dianne Martin and Eric Murchie-Beyma. Eugene, OR: International Society for Technology in Education, 1992. 19 - 32.

Keywords: Software, Culture, Attitudes and expectations, Use patterns, Context

Investigation of social psychology of human/computer interaction. Researchers found male/female differences in software use and preferences, as well as public vs. private use.

Hughes, Martin, Ann Brackenridge, Alan Bibby, and Pam Greenhough. "Girls, Boys and Turtles: Gender Effects in Young Children Learning with Logo." Girls and Computers. Ed. Celia Hoyles. Vol. Bedford Way Papers 34. London: Institute of Education, University of London, 1988.

Keywords: Single-sex environment

7-year-old children in male, female, and mixed pairs intereracted with the LOGO turtle. The female pairs achieved significantly below the male and mixed pairs: "The findings reported above are quite unexpected, in that nothing similar appears to have been reported previously in the research literature." (p. 36)

Humphreys, Sheila, and Ellen Spertus. "Leveraging an Alternative Source of Computer Scientists: Reentry Programs." SIGCSE Bulletin 34.2 (2002): 53-56.

Keywords: Adults, Interventions, School programs

Describes three programs. 1) The CS Reentry Program at the University of California at Berkeley starting in 1983, to enlarge the pool of women and minority computer scientists qualified for university and college research and teaching positions. It consisted of a transitional period in which students had no formal student status while taking the same courses as undergraduate majors. Of the 156 students who went through the program, 27 got or were getting a Ph.D. in CS. 2) The New Horizons College Certificate Program at Mills College started in 1984 by Lenore Blum to enable women and men with bachelor's degrees in other fields to enter CS careers or graduate education. The program had 12 men and 46 women since then. 3) Interdisciplinary Computer Science at Mills College: a Master of Arts degree in CS and music, economics, user interface design, education and other areas. Dozens of women and men went through this program. At Mills College 3/4 of full-time faculty are women, as are most of the students.

Huyer, Sophia. Gender, Ict, and Education. Unpublished manuscript.

Keywords: Barriers, Attitudes and expectations, Interventions, Cross-cultural, Outside U.S.

Discusses women's underrepresentation in technology and science internationally: cultural and attitudinal barriers, situational barriers (e.g. lack of family or partner support), qualification

barriers, and institutional barriers. Cites a Nigerian study by Oolajire Bosede Ajayi and Dolly A. Ighoroje Ahbor in which women believed that IT overexposes young women to a Western lifestyle, making them too "worldly-wise" and thus endangering their chances for marriage. In India, though, women's particiption in IT is strong, for reasons that are not clear. The Open University in the UK developed a bridge course in computing for beginners to attract more females to IT.

---. Position Paper on Gender and Science and Technology from an International Perspective: UN Commission on Science and Technology for Development, 2004.

Keywords: Barriers, Extracurricular programs, Cross-cultural, Outside U.S.

Mentions IBM-sponsored camps for middle-school girls, Exploring Interests in Technology and Engineering (EXITE), in North America, Latin America, Europe, Africa, and Asia-Pacific. Barriers are poverty and inflexible scheduling in many developing countries.

Information Technology Association of America. Report of the Itaa Blue Ribbon Panel on It Diversity. Arlington, VA, 2003.

Keywords: Career factors, Barriers, Role models and mentors, Culture, Stereotypes and bias

Women are under-represented in IT education and workforce. Barriers: lack of role models, lack of information about career requirements, unattractive IT environment, stereotypes. Recommendations include stronger corporate action.

Inkpen, Kori, Rena Upitis, Maria Klawe, Joan Lawry, Ann Anderson, Mutindi Ndunda, Kamran Sedighian, Steve Leroux, and David Hsu. "We Have Never-Forgetful Flowers in Our Garden": Girls' Responses to Electronic Games, N.D.

Keywords: Games, Outside U.S.

In a science museum in Canada, girls were obseved playing electronic games, both video and computer. They preferred playing them socially and preferred computer games over video games.

Inzlicht, Michael, and Talia Ben-Zeev. "A Threatening Intellectual Environment: Why Females Are Susceptible to Experiencing Problem-Solving Deficits in the Presence of Males." Psychological Science 11.5 (2000): 365-71.

Keywords: Critical mass, Stereotype threat, Mathematics

Female undergraduates experienced stereotype threat (measured by lower scores) while taking a math test but not a verbal test. In a second experiment with only a math test, their scores were somewhat lower when they took the test in small groups with males rather than only with other females. This is not specifically about computers but it makes important points about critical mass and stereotype threat.

Irwin, Leslie. "Gender Inequities in Technology in Developing Nations: Females and Computers in Traditional Cultures." Intercultural Education 11.2 (2000): 195-200.

Keywords: Culture, Cross-cultural, Outside U.S.

Computers reflect their creators: American western males. There is a disharmony between the creator culture and the user culture, particularly in developing countries and especially for the females among them. Computer ownership in 1999 was 6% in Ghana and 9% in China at a time it was 78% in the United States, and most of those owners were male. Implications for education include special efforts to introduce computers to women and to train teachers to counsel girls toward professions in technology.

Jacobson, Frances F. "Gender Differences in Attitudes toward Using Computers in Libraries: An Exploratory Study." Library and Information Science Research 13 (1991): 267-79.

Keywords: Attitudes and expectations

Academically oriented high school students were studied about computer attitudes with respect to using computers for library research. Girls had significantly higher computer anxiety and more anxiety about using computers for library research than boys. By the end of the academic year, girls' increased comfort level with using computers in general was not enough to offset their anxiety about using computers in libraries.

Jagacinski, Carolyn M., William K. LeBold, and Gavriel Salvendy. "Gender Differences in Persistence in Computer-Related Fields." Journal of Educational Computing Research 4.2 (1988): 185-202.

Keywords: Retention, Postsecondary/tertiary, Role models and mentors

Over 3,000 American undergraduate students in CS, computer technology, electrical/computer engineering and industrial engineering were studied to determine factors related to persistence or nonpersistence in their major. In CS women (as opposed to CS men and men and women in the other fields), there were few differences between persisters and nonpersisters. Article refers to a

program in the early 70's for women in science: a group with role models were twice as likely to persist as the control group.

Jakobsdottir, Solveig, Cynthia L. Krey, and Gregory C. Sales. "Computer Graphics: Preferences by Gender in Grades 2, 4, and 6." Journal of Educational Research 88.2 (1994): 91-100.

Keywords: Stereotypes and bias, Graphics

After reviewing literature, researchers came up with a list of graphic elements (content, color, characters, atmosphere) that appealed to boys, those that appealed to girls, and those of equal interest. Testing the computer graphics confirmed boys' and girls' preferences for such pictures. Authors recommend using mixed images from both categories.

Jenkins, Edgar W. "Gender and Science and Technology Education." UNESCO International Science, Technology, and Environmental Newsletter 1 (1997): 1-2.

Could not obtain: not reviewed.

Jennings, Susan Evans, and Anthony J. Onwuegbuzie. "Computer Attitudes as a Function of Age, Gender, Math Attitude, and Developmental Status." Journal of Educational Computing Research 25.4 (2001): 367-84.

Keywords: Attitudes and expectations

A study of students in three age groups found no main effect for gender with respect to dimensions of computer attitude (anxiety, confidence, liking, and usefulness). (Reviewed abstract only)

Jenson, Jennifer, Suzanne de Castell, and Mary Bryson. ""Girl Talk": Gender, Equity, and Identity Discourses in a School-Based Computer Culture." Women's Studies International Forum 26.6 (2003): 561-73.

Keywords: Interventions, Role models and mentors, Single-sex environment, Culture, Outside U.S.

In a Canadian school, female teachers and girls ages 9-13 were given first training on the new computers, who then provided training to male teachers and boys in an effort to provide technological competence and role models to females. In addition, female "experts" taught other classes of boys and girls on the new computers. Staff and parents were uncomfortable with the notion that this procedure was being followed for reasons of gender equity ("reverse discrimination"), so the researchers downplayed the gender aspect to retain cooperation. Toward the end of the year, however, teachers noticed that girls were speaking out more about what they perceived as gender inequities, and not only with the computers. The girls felt their competence with computers had increased, partly because of the all-girls context in which they had learned. Perhaps because the inequities were not named or identified as "gender-related," they returned the year after the project, unresisted by participating teachers and students, back to "gendered business as usual." (p. 569)

Jepson, Andrea, and Teri Perl. "Priming the Pipeline." SIGCSE Bulletin 34.2 (2002): 36-39.

Keywords: Pipeline, Role models and mentors, Career factors, Media, Stereotypes and bias

Comments:

A telephone survey using random digit dialing methodology in the Silicon Valley, Boston and Austin was conducted of 652 college-bound high school female students. Asked "Why are girls less likely to pursue computer science careers?" answers in order of frequency were: 1) Not enough role models. 2) Women have other interests, including family. 3) Didn't know about the industry. 4) Limited opportunity to use computers. 5) Negative media. 6) Too nerdy.

Jessup, Elizabeth R., and Tamara Sumner. "Design-Based Learning and Women's Participation in It." Frontiers: A Journal of Women Studies 26.1 (2005).

Keywords: Postsecondary/tertiary, School programs, Curriculum, Enrollments

An undergraduate CS course has students creating software for local community service agencies. The course attracts a larger proportion of female students than other CS courses.

Johnson, Carole Schulte, and Karen F. Swoope. "Boys' and Girls' Interest in Using Computers: Implications for the Classroom." Arithmetic Teacher 35.1 (1987): 14-16.

Keywords: Attitudes and expectations

About 1200 students from grades 1-12 were surveyed about their interest in computers. Both boys and girls showed high interest in computer for themselves but both sexes perceived boys' interest as significantly higher than that of girls.

Johnson, Deborah G., and Keith W. Miller. "Is Diversity in Computing a Moral Matter?" SIGCSE Bulletin 34.2 (2002): 9-10.

Keywords: Departmental change, Policy

Argues that factors that make CS unattractive to women are unnecessary to the conduct of computing and harmful to the field, and have the unethical effect of discriminating against women.

Johnson, James P. "Can Computers Close the Educational Equity Gap?" Civil Rights Quarterly Perspectives 14.3 (1982): 20-25.

Keywords: Early work, Race, ethnicity, or SES

In this article there is a concern that the new computer technology may exacerbate inequalities in gender, race/ethnicity, and SES.

Johnson, Robert T., David W. Johnson, and Mary Beth Stanne. "Effects of Cooperative, Competitive, and Individualistic Goal Structures on Computer-Assisted Instruction." Journal of Educational Psychology 77.6 (1985): 668-77.

Keywords: Culture, Middle school, Attitudes and expectations

Researchers studied 8th graders using computer-assisted instruction in cooperative, competitive, and individualistic learning environments. Girls' attitudes, compared with those of boys, were adversely affected in the competitive condition.

Joiner, Richard, David Messer, Karen Littleton, and Paul Light. "Gender, Computer Experience and Computer-Based Problem Solving." Computers and Education 26.1-3 (1996): 179-97.

Keywords: Software, Experience, Stereotypes and bias, Games, Outside U.S.

Sixty-five 10- and 11-year-old children in England were given a male-stereotyped and a female-stereotyped version of software (pirates and princesses, both adventure games, which were structually identical except for the sex of the good and evil characters, either all male or all female). Their performance was correlated with home computer use, school computer use, and the use of a computer mouse. Kids completed questionnaires a week before using the software. They did both pieces of software 20 minutes apart, then a final questionnaire. Boys performed better in both games than girls and better regardless of which was done first or second. Girls preferred the Princesses version slightly more; there was no difference for the boys, but preference for the Princesses for girls correlated positively with higher performance on it (not true for boys). Although boys had more experience and experience correlated positively with performance, the gap remained even when experience was removed. And obviously changing the gender of the characters didn't make a difference. The intrinsic interest of the software is an important factor in girls' (but not boys') computer involvement.

Jones, P.K. "The Relative Effectiveness of Computer-Assisted Remediation with Male and Female Students." Technological Horizons in Education Journal 3 (1987): 61-63.

Could not obtain: not reviewed.

Jones, Trudi, and Valerie A. Clarke. "Diversity as a Determinant of Attitudes: A Possible Explanation of the Apparent Advantage of Single-Sex Settings." Journal of Educational Computing Research 21.1 (1995): 51-64.

Keywords: Single-sex environment, Attitudes and expectations, Experience, Outside U.S.

231 15-year-old high school girls in Victoria, Australia in 3 single-sex (government, independent, and Catholic) and two coed (government and independent) schools were studied for computer attitudes. Girls from single-sex settings had more experience with computers and more positive attitudes than girls in coed settings. However, when computer experience was held constant, there was no effect of educational setting on computer attitudes. The strongest predictor of positive computer attitudes (affective, cognitive, and behavioral) was diversity of computing experience.

Jussim, Lee, and Jacquelynne S. Eccles. "Teacher Expectations Ii: Construction and Reflection of Student Achievement." Journal of Personality and Social Psychology 63.6 (1992): 947-61.

Keywords: Teachers and faculty, Stereotypes and bias, Mathematics

In an experiment involving teachers' expectations of 6th graders' math achievement, their expectations predicted student achievement beyond effects accounted for by previous achievement and motivation. Teachers expected boys to have more math talent and girls to work harder, but both perceptions are erroneous.

Kadijevich, Djordje. "Gender Differences in Computer Attitude among Ninth-Grade Students." Journal of Educational Computing Research 22.2 (2000): 145-54.

Keywords: Attitudes and expectations, Outside U.S.

Ninth grade students in Belgrade, Yugoslavia were surveyed about computer attitudes. Males had a more positive attitude than females, even when experience was controlled. However, when attitude

was controlled there was no gender difference in experience. While males showed more interest in computers than females, this did not account for the gender difference in computer attitude.

Kanter, Rosabeth Moss. Men and Women of the Corporation. New York: Basic Books, 1977.

Keywords: Retention, Career factors, Critical mass

The classic work on the social dynamics that occur when there is a majority and a minority.

Kanter, Rosabeth Moss, and Barry A. Stein. A Tale Of "O": On Being Different. Goodmeasure, Inc., Melrose, MA, 1993.

Keywords: Critical mass, Culture

18-minute and 27-minute versions of videotape on the social dynamics of being an X, a member of a majority, and an O, a member of a minority. Highly recommended for professional development events.

Kay, Robin. "An Analysis of Methods Used to Examine Gender Differences in Computer-Related Behavior." Journal of Educational Computing Research 8.3 (1992): 277-90.

Keywords: Research review, Attitudes and expectations, Experience, Use patterns, Methodology

A research review of empirical methods used to collect data on gender differences in computer-related behavior attributes numerous instances of inconsistencies to methodology mistakes: 1) sample selection, 2) sample size, 3) scale development, 4) scale quality, 5) use of univariate and multivariate analyses, 6) regression analysis, 7) construct definition, 8) construct testing, and 9) presentation of results. ***Attitude****: out of 98 studies, males had more positive attitudes in 48, females in 14, and similar in 36. Attitudes toward computers have been defined in at least 14 different ways.* ***Aptitude (skill, abilities)****: males performed better than females in 15 of 32 studies, equal in 13, and females better in 5, with varied definitions.* ***Use****: Males more in 30 of 38 studies, 4 equal, and females more in 4. Definitions of use here varied from camp participation to computer ownership and others. "A detailed and comprehensive review of methods used to examine gender differences in attitudes and aptitude reveals that a number of procedural flaws significantly limit the consistency, validity and impact of many studies." (p. 278) "The principle [sic] constructs addressed in computer-behavior research are attitudes, aptitude, and use, yet there is no common definition of these terms." (p. 283)*

---. "Understanding Gender Differences in Computer Attitudes, Aptitude, and Use: An Analysis of Method." National Educational Computing Conference. Nashville, TN, 1990.

Could not obtain: not reviewed.

Kay, Robin H. "A Critical Evaluation of Gender Differences in Computer-Related Behavior." Computers in the Schools 9.4 (1993): 81-93.

Keywords: Attitudes and expectations, Mathematics, Outside U.S.

647 pre-service teachers (about 3/4 female) in Ontario, Canada were given assessments of computer attitude, computer ability, perceived control, computer use, math/science ability, and verbal skills. Males and females differed only with respect to ability to use computers and perceived control over computers, but these differences were almost entirely eliminated when math/science and verbal ability were controlled for. Math/science ability appears to be related to computer ability.

---. "Understanding Gender Differences in Computer Attitudes, Aptitude, and Use: An Invitation to Build Theory." Journal of Research on Computing in Education 25.2 (1992): 159-71.

Keywords: Attitudes and expectations, Methodology

The author argues that a qualitative, contextual, developmental approach is better than a quantitative, approach to understand gender differences rather than merely identifying them.

Kekelis, Linda S., Rebecca Wepsic Ancheta, and Etta Heber. "Hurdles in the Pipeline: Girls and Technology Careers." Frontiers: A Journal of Women Studies 26.1 (2005).

Keywords: Extracurricular programs, Career factors, Barriers, Stereotype threat, Parents and home, Race, ethnicity, or SES

Techbridge was a before- and after-school technology program for girls in 2000-2003 that was hosted at 11 elementary, middle, and high schools in the Bay Area. Interviews and focus groups were conducted with 126 girls ages 12-15 and 34 parents/guardians. Even girls with positive experiences in the program did not aspire to technology careers. Reasons: negative stereotypyes about computing jobs (which remained as girls got older), disconnect between dreams and plans, little career info, lack of info about career preparation, and lack of career guidance and lack of targeted (as opposed to general) support from family. White parents were likelier to give vague support than parents of color, and higher SES parents were least likely to discuss careers.

Families where someone had a technical career were more likely to provide guidance on technical careers.

Kekelis, Linda S., Rebecca Wepsic Ancheta, Etta Heber, and Jeri Countryman. Bridging Differences: How Social Relationships and Racial Diversity Matter in a Girls' Technology Program.

Keywords: Single-sex environment, Extracurricular programs, Role models and mentors, Race, ethnicity, or SES, School programs, Attitudes and expectations

Techbridge was a before- and after-school technology program for girls in 2000-2003 that was hosted at 11 elementary, middle, and high schools in the Bay Area. Interviews and focus groups were conducted with girls ages 12-15, parents, teachers, and project staff. One middle school adopted the program as an elective course. Girls joined in part because of the all-girls aspect, for friendships and social experiences. Some of the programs developed problems about racial differences among the girls when they self-segregated by race. When a girl in a minority group in the program dropped out, her friends often followed. Teachers and project staff tried interventions to bridge the racial groups: transition time with snacks and icebreakers, learning station activities (e.g., downloading photos, etc.), service learning projects (e.g. mentoring younger students), and diversity training for teachers. Teachers and staff noted improvements in the social dynamics following the interventions. Sometimes a girl's short-term resistance to contacts with a girl of another race softened over time, but sometimes the effort backfired. Girls with lower technical skills and self-confidence were at particular risk of dropping out from attempts to force them to cross racial lines. When interventions succeeded they reduced stereotypes and divisions between groups of girls.

Keller, Johannes. "Blatant Stereotype Threat and Women's Math Performance: Self-Handicapping as a Strategic Means to Cope with Obtrusive Negative Performance Expectations." Sex Roles: A Journal of Research 47.3/4 (2002): 193-98.

Keywords: Stereotype threat, Mathematics

In an experiment with high school students, a stereotype threat condition led to decreased math performance and increased self-handicapping tendencies in women.

Keough, Teresa, Peter Barnes, Richard Joiner, and Karen Littleton. "Gender, Pair Composition and Computer Versus Paper Presentations of an English Language Task." Educational Psychology 20.1 (2000): 33-43.

Keywords: Single-sex environment, Classroom interactions, Pedagogy

Pairs of 13- to 14-year old students were studied in either same-sex or mixed sex configurations, doing an English language task on either the computer or on paper. In the paper presentation there was no difference between the single-sex and mixed-sex pairs, but in the computer presentation boys dominated both the amount and type of verbal interaction and control of the mouse. (Reviewed abstract only)

Kersteen, Zoe A., Marcia C. Linn, Michael Clancy, and Curtis Hardyck. "Previous Experience and the Learning of Computer Programming: The Computer Helps Those Who Help Themselves." Journal of Educational Computing Research 4.3 (1988): 321-33.

Keywords: Experience, Extracurricular programs

First-year programming students at the University of California at Berkeley were surveyed. Males were found to have more prior experience with computers than females, especially in advanced computer science topics. Much of the males' prior experience was gained outside of school through unguided exploration.

Kiesler, Sara, Lee Sproull, and Jacquelynne S. Eccles. "Pool Halls, Chips, and War Games: Women in the Culture of Computing." Psychology of Women Quarterly 9 (1985): 451-62.

Keywords: Software, Culture, Early work

The world of computing seems to be more consistent with male adolescent culture than with feminine values and goals. Furthermore, both arcade and educational software is designed with boys in mind.

---. "Second Class Citizens?" Psychology Today (1983): 41-48.

Keywords: Early work, Software, Culture, Extracurricular programs

A study of software for children, both recreational in computer arcades and educational, indicates that the software is designed by and for males.

Kiesler, S. et al. "Cultural Socialization to Computing in College." Computers in Human Behavior 2.4 (1986): 257-75.

Could not obtain: not reviewed.

Kimbrough, Doris R. "On-Line "Chat Room" Tutorials: An Unusual Gender Bias in Computer Use." Journal of Science Education and Technology 8.3 (1999): 227-34.

Keywords: Telecommunications, Distance education

Students taking a distance education chemistry tutorial were studied. Higher percentages of female students participated, and participated with greater frequency than males. The correlation between frequency of participation and course performance was higher for females than males. (Reviewed abstract only)

King, John, Trevor Bond, and Sonya Blandford. "An Investigation of Computer Anxiety by Gender and Grade." Computers in Human Behavior 18.1 (2002): 69-84.

Keywords: Attitudes and expectations, Games, Curriculum

910 students in grades 7, 9, and 11 were studied to assess computer anxiety, with a focus on the test and measurement aspect. Overall they found males slighly more computer anxious than females. Females' anxiety levels were higher than males' in grade 7, about equal in grade 9, and lower in grade 11. Possible reasons: by grade 11 computers are used more for communications and less for games, become more common in the curriculum, and in their association with academics become less "cool" for males. "This could suggest a changeover period around grade 9 above which grade the females become measurably less anxious about using computers compared to males." (p. 79)

King, Lisa K. "Gender Issues in Online Communities." The CPSR Newsletter (Computer Professionals for Social Responsibility) 18.1 (2000).

Keywords: Telecommunications, Single-sex environment

Discusses online communities and male vs. female communication patterns. Conclusion: "Where there are no women-friendly spaces, women-only forums may be the best alternative."

Kirk, David. "Gender Issues in Information Technology as Found in Schools: Authentic/Synthetic/Fantastic?" Educational Leadership 32.4 (1992): 28-31.

Keywords: Research review

Reviews research in 3 categories: the computer gender gap doesn't really exist and has been fabricated (fantastic), it exists but is socially constructed (synthetic), or it exists and is innate (authentic). Because schools perpetuate biases of the past, they can have only minimal influence on change in gender patterns.

Kirkman, C. "Computer Experience and Attitudes of 12-Year-Old Students: Implications for the Uk National Curriculum." Journal of Computer Assisted Learning 9 (1993): 51-62.

Keywords: Attitudes and expectations, Use patterns, Parents and home, Race, ethnicity, or SES, Outside U.S.

12-year-old students in the UK were surveyed about computer use, attitude, SES (measured by newspapers in the home), and gender. Nearly twice as many boys than girls used computers at home, and for more hours/week. Home computer use had a stronger effect on girls' computer attitudes than boys'. Higher SES girls showed a more positive computer attitude than low SES girls, with middle SES in the middle; however, lower SES boys had more positive computer attitudes, with high next and middle last. For boys, the same pattern held for enthusiasm and time on the home computer.

Kirkpatrick, Heather, and Larry Cuban. "Should Be We Worried? What the Research Says About Gender Differences in Access, Use, Attitudes, and Achievement with Computers." Education and Computing 38.4 (1998): 56-61.

Keywords: Research review, Experience, Use patterns, Access, Age, Extracurricular programs, Parents and home, Teachers and faculty, Role models and mentors, Culture, Single-sex environment, Interventions, Mathematics

When males' and females' experience and use patterns are held constant, their achievement and attitudes are similar from primary through higher education. However, "research shows clearly that males use computers more often, in more places, and for more purposes than do females; furthermore, these disparities increase with age." (p. 56) Males had more access to home computers and were more likely than females to learn how to use them at home. Since the 70's there have been about six times more male CS Ph.D.s than female. As age increases, so does use, confidence, and positive attitudes.

Achievement differences correlate with types and amount of use, not inherent differences in preference or ability. Explanations of the gaps: Teachers and guidance counselors, parents, lack of role

models, culturally a male enterprise, and association with math. Some researchers propose single-sex settings and structured after-school activities like those that worked in the 70's to improve girls' math achievement and attitudes.

Kirkup, G. "The Importance of Gender as a Category in Open and Distance Learning." Putting the Learner First: Learner-Centered Approaches in Open and Distance Learning. Cambridge, UK, 1995.

Could not obtain: not reviewed.

Kirkup, Gill. "The Social Construction of Computers: Hammers or Harpsichords?" Inventing Women: Science, Technology and Gender. Eds. Gill Kirkup and L.S. Keller. Cambridge, UK: Polity Press, 1992.

Keywords: Single-sex environment, Attitudes and expectations

Cites Hughes et al. (1988): in some situations single-sex groupings of girls attempting a computing task perform worse than a mixed group since their lack of confidence can lead to mutual recrimination and failure. Don't have more info about the Hughes cite.

Klawe, Maria, and Nancy Leveson. "Refreshing the Nerds." Communications of the ACM 44.7 (2001): 67 ff.

Keywords: Adults, Career factors, Culture, Attitudes and expectations, Postsecondary/tertiary, School programs, Outside U.S.

Describes a survey of high school students in Vancouver BC, which found that students associated nerdy characteristics with people who have computer careers: not very attractive. Describes the ARC project (Alternate Routes to Computing) that enables people with bachelors degrees in other fields to enter computer careers via a two-year program. The project especially targeted women, including those who had been out of the work frce for some time. More than half the students since its 1998 inception have been women.

---. "Women in Computing: Where Are We Now?" Communications of the ACM 38.1 (1995): 29-35.

Keywords: Parents and home, Experience, Outside U.S.

In New Zealand researchers found that girls were less likely to have home computers bought for them, and those who did have computers were more obliged than brothers were to share them with siblings. Also in N.Z., a study found that males had considerably more prior experience than females.

Knupfer, Nancy Nelson. "Gender Divisions across Technology Advertisements and the Www: Implications for Educational Equity." Theory into Practice 37.1 (1998): 54-63.

Keywords: Media, Stereotypes and bias, Telecommunications

The article examines commercial ads about and with computerized technology and reveals patterns of gender stereotyping that have moved across the various media and are now evident in the World Wide Web environment. The ads reflect characteristics of advertisements found elsewhere about technology and thus keep technology in the male domain by promoting continued gender stereotyping.

---. "Gendered by Design." Educational Technology.March/April (1997).

Keywords: Stereotypes and bias, Curriculum, Culture, Distance education

Article concerns the need for instructional designers in the technology area to get past stereotypes and be more gender-fair.

---. "New Technologies and Gender Equity: New Bottles with Old Wine." Association for Educational Communications and Technology. Albuquerque, NM: ERIC: ED 409843, 1997 of Proceedings of Selected Research and Development Presentations.

Keywords: Media, Stereotypes and bias, Telecommunications

The paper discusses developing male and female stereotypes in technology advertisements; culture and groups; and gender stereotypes in print media, television, cyberspace, and ITV educational environments.

Knupfer, Nancy Nelson, Kevin M. Kramer, and Debra Pryor. "Gender Equity on-Line: Messages Portrayed with and About the New Technologies." International Visual Literacy Association. Cheyenne, WY: ERIC: ED 408994, 1997. 391-99 of VisionQuest: Journeys Toward Visual Literacy.

Keywords: Telecommunications, Stereotypes and bias, Media

They examined a sample of magazines and promotional materials about multimedia technology that were available to the general public and teachers, as well as television and Internet advertisements for technology. There were three times more male than female characters associated with the products being sold, especially in ads aimed at children and teenagers. Women were consistently portrayed as subservient, in the background, or not using the technology productively.

Knupfer, Nancy Nelson, William J. Rust, and Judy E. Mahoney. "Out of the Picture, out of the Club: Technology, Mass Media, Society, and Gender." International Visual Literacy Association. Cheyenne, WY: ERIC: ED 408992, 1997.

Keywords: Media, Telecommunications, Stereotypes and bias, Culture, Parents and home

The paper covers the computer culture, ads and visual messages about technology in the entertainment industry, differences in online communication styles between males and females, and the role of parents and teachers in separating males and females.

Koch, Melissa. "No Girls Allowed!" Technos 3.3 (1994): 14-19. ERIC: EJ 491466.

Keywords: Stereotypes and bias, Software, Single-sex environment, Role models and mentors, Games

Discusses girls' use of computers and examines why they are often discouraged and lose interest. Topics include the issue of gender, gender bias in computer games, use of the Internet, exposure to technology, girls' preferences, educational reform, choosing software, technology programs for all-girl classrooms, and role models.

Kolehmainedn, P. "The Changes in Computer Anxiety in a Required Course." European Conference on Educational Research. Enschede, the Netherlands, 1992.

Could not obtain: not reviewed.

Koohang, Alex A. "Effects of Age, Gender, College Status, and Computer Experience on Attitudes toward Library Computer Systems (Lcs)." Library and Information Science Research 8 (1986): 349-55.

Keywords: Attitudes and expectations, Age

60 college students were surveyed about their computer attitudes: anxiety, confidence, and liking. Age, gender, and college status did not make a significant difference on the three subscales.

---. "A Study of the Attitudes of Pre-Service Teachers toward the Use of Computers." Educational Communications and Technology Journal 35.3 (1987): 145-49.

Keywords: Attitudes and expectations, Experience, Teachers and faculty

60 education students were surveyed about computer attitudes and experience. Males showed less anxiety and more confidence, but MANOVA results showed that this was not significant on overall computer subscales.

Koohang, Alex A., and David M. Byrd. "A Study of Attitudes toward the Usefulness of the Library Computer System and Selected Variables: A Further Study." Library and Information Science Research 9.1 (1987): 105-11.

Keywords: Experience, Attitudes and expectations

Students enrolled in a library course at Southern Illinois University/Carbondale were surveyed in connection with the Library Computer System to test variables associated with attitudes toward the usefulness of the system. Gender did not produce a significant difference but prior experience did. The paper did not correlate prior experience with gender.

Korenman, Joan. "Email Forums and Women's Studies: The Example of WMST-L." Cyberfeminism: Connectivity, Critique and Creativity. Eds. Susan Hawthorne and Renate Klein. North Melbourne, Australia: Spinifex Press, 1999. 80-97. Keywords:

Not reviewed.

---. "A URL of Our Own: The Center for Women & Information Technology." Women's Studies Quarterly 29.3-4 (2001): 148-55.

Not reviewed.

---. "Women, Women Everywhere: Looking for a Link." CyberPsychology and Behavior 3.5 (2000): 721-29.

Not reviewed.

Korenman, Joan, and Nancy Wyatt. "Group Dynamics in an E-Mail Forum." Computer-Mediated Communication: Linguistic, Social and Cross-Cultural Perspectives. Ed. Susan C. Herring. Amsterdam: John Benjamins, 1996. 225-42. Keywords:

Not reviewed.

Kramer, Pamela E., and Sheila Lehman. "Mismeasuring Women: A Critique of Research on Computer Ability and Avoidance." Signs: Journal of Women in Culture and Society 16.1 (1990): 158-72.

Could not obtain: not reviewed.

---. Women and Technology: Contextualizing the Issues. New York: Polytechnic University.

Keywords: Early work, Mathematics, Culture, Experience

Adult women returning to postsecondary education had no trouble with their mathematics courses but two-thirds of them dropped or failed their computer programming courses. The authors speculate that "this difficulty must be related to the way in which computer courses are conducted in an

engineering environment, and to the women's lack of preparation for this 'computer culture' as opposed to the environment of the mathematics courses."

Kraut, Robert et al. "The HomeNet Field Trial of Residential Internet Services." Communications 39.12 (1996): 55-63.

Could not obtain: not reviewed.

Krendl, Kathy A., Mary C. Broihier, and Cynthia Fleetwood. "Children and Computers: Do Sex-Related Differences Persist?" Journal of Communication 39.3 (1989): 85-93.

Keywords: Attitudes and expectations, Experience, Use patterns, Research review

The literature to date is reviewed in 4 areas: confidence in computer skills, interest, perceived value, and experience/diversity of use. Over 2500 students in grades 4 to 10 were given surveys about computers for three years in a row. Boys continued to report significantly higher levels of confidence over time compared to girls, even when experience and value were held constant. Ratings of confidence and interest decreased over time for both bys and girls but ratings of value increased. Conclusion: "boys and girls respond differently to computers even as they gain experience with them over time." (p. 91). The more experienced students got with computers, the less confidence in their skills they had, and this was truer of girls than boys, so more experience alone will not close the computer gender gap.

Kwan, Steven K., Eileen M. Trauth, and Kathleen C. Driehaus. "Gender Differences and Computing: Students' Assessment of Societal Influences." Education and Computing 1 (1985): 187-94.

Keywords: Role models and mentors, Media, Stereotypes and bias

High school students were surveyed regarding their assessment of societal influences on their participation in computing. Students, especially females, rejected common stereotypes. Students rejected the notion that the number of women role models bears any relationship to the number of girls taking computer courses, but they did agree that computing was seen as male by the media.

Lage, Elisabeth. "Boys, Girls, and Microcomputing." European Journal of Psychology of Women 6.1 (1991): 29-44.

Keywords: Elementary/primary, Middle school, Attitudes and expectations, Outside U.S.

Translated from French (author works in Paris). French elementary students considered both boys and girls to be equally involved in technical fields and that female computer enthusiasts were thought attractive. At the junior high level, students no longer perceived gender equality in technical interests and judged female computer enthusiasts negatively. At this age girls considered that too keen an interest in computers was evidence of loneliness and problems with sexual identity; boys' involvement with computers did not change their self-image.

Lakoff, Robin Tolmach, and Raquel Scherr Salgado. "Double Talk: Sexism in Tech Talk." Future, Techology, and Woman. San Diego State University, 1981. 46-54.

See title.

Land, M.J. "Evidence of Gender Disparity in Children's Computer Use and Activities." Association for Education in Journalism and Mass Communication. New Orleans, 1999.

Keywords: Parents and home, Use patterns

Children ages 9-14 were studied about their home computer use. Males spent more time, except for on-line, than females. Game playing was equal but females spent more time with word processing and desktop publishing. Female on-line time was primarily for communication, while that of males was primarily for games.

Lanius, Cynthia. Girltech: Getting Girls Interested in Computer Science. N.D. Available: http://math.rice.edu/~lanius/club/girls3.html. November 23, 2004.

Keywords: Applications, High school learning & achievement, Experience

High school girls who said they liked computers actually liked using computer applications.

Larson, M. "Guidelines for Selecting Equitable Electronic Software." Equity Coalition 5.20/21 (1999): 25.

Could not obtain: not reviewed.

Latvika, V. et al. "Sex Differences in Computing Behaviour among Secondary School Pupils." New Zealand Journal of Educational Studies 22.2 (1987): 201-15.

Could not obtain: not reviewed.

Lee, A.C.K. "Undergraduate Students' Gender Differences in It Skills and Attitudes." Journal of Computer Assisted Learning 19.4 (2003): 488 ff.

Keywords: Attitudes and expectations, Outside U.S.

Before starting their first year at the University of Hong Kong, students took a year-long computer course. Girls achieved greater improvements in their computer skills than boys, which in turn

boosted girls' confidence in their IT ability. Girls estimates of their skill levels doubled from 1998 to 2000. Nevertheless, girls were less confident of their computer abilities and skills than boys as found in surveys of new university students upon entrance. (Abstract only)

Lee, Kar-Tin. "Impediments to Good Computing Practice: Some Gender Issues." Computers and Education 28.4 (1997): 251-59.

Keywords: Barriers, Teachers and faculty, Outside U.S.

In a study of 100 computer-using secondary teachers in Australia. Men used computers more and for more purposes, and were more confident about their skills. Women were more likely to blame themselves for their lack of confidence. Men complained more about barriers posed by lack of funds, hardware, access at school, bugs in computer systems, and lack of physical space. Women complained more about human resources problems (e.g. computer coordinator too busy to help), access at home, and lack of their own knowledge.

Lee, Miwha. "Gender, Group Composition, and Peer Interaction in Computer-Based Cooperative Learning." Journal of Educational Computing Research 9.4 (1993): 549-77.

Keywords: Pedagogy, Classroom interactions, Single-sex environment

Most studies on small group learning report that males tend to dominate verbal activity in mixed-gender groups. 5th and 6th graders were studied to determine if group gender composition in computer tasks had an effect on interaction behavior. About half the boys and the girls owned home computers. They were placed in four-person groups: same sex, majority female, equal M/F, and majority male. Groups were given "Where in the World is Carmen Sandiego?" to solve. Interactions were videotaped, coded and recorded. Males became more verbally active and females less so in mixed gender groups, but all-female groups had slightly more positive interactions at the computer than the mixed groups, while all-male groups did a great deal worse than the others.

Leong, Siew Chee, and Suliman Hawamdeh. "Gender and Learning Attitudes in Using Web-Based Science Lessons." Information Research 5.1 (1999).

Keywords: Pedagogy, Parents and home, Classroom interactions, Telecommunications, Single-sex environment, Outside U.S.

A class of 11-year-olds in Singapore was studied. Boys reported spending more time on home computers at games and had more Web experience than girls. Girls preferred a web-based lesson than the traditional classroom lesson. Girls learned more working in pairs and preferred working in pairs, while boys learned less in pairs and preferred working alone. Unlike girls, boys disliked reading from computer screens because they had difficulty reading long pages of text on the screen.

Lepper, Mark R. "Microcomputers in Education: Motivational and Social Issues." American Psychologist 40.1 (1985): 1-18.

Keywords: Games

One reason for girls' lower participation with computers may be the themes of war, violence, and sports in educational games for children, which "are not optimal for interesting girls in the world of computers." (p. 15)

Leveson, Nancy G. "Educational Pipeline Issues for Women." Computing Research Association. Snowbird, 1990.

Keywords: Pipeline, Postsecondary/tertiary, Attitudes and expectations, Classroom interactions, Barriers

Women drop out of CS in graduate school due to different pressures than men experience in financial support; self-confidence; feelings of powerlessness, invisibility and isolation; fewer publishing opportunities; advisors' lowered expectations; lower evaluations; and inappropriate treatment from faculty and students. The author recommends increased awareness from faculty about differential treatment and experiences.

Levin, Barbara B., and Sean M. Barry. "Children's Views of Technology: The Role of Age, Gender, and School Setting." Journal of Computing in Childhood Educa;tion 8.4 (1997): 267-90.

Keywords: Elementary/primary, Software, Attitudes and expectations, Parents and home

K-5 children drew a technologist and were interviewed about their understanding of computer hardware and software. Most boys drew pictures of males and most girls of females at all grade levels. Home/school settings were analyzed in drawings and in terms of access: girls and boys were equally likely to have a home computer. Girls said their fathers or parents bought it and used it most; boys said their fathers bought it and they used it most. Most children could name

software with male characters but few could name software with female characters. The children seemed to think of computer technology as more for males than females.

Levin, Tamar, and Claire Gordon. "Effect of Gender and Computer Experience on Attitudes toward Computers." Journal of Educational Computing Research 5.1 (1989): 69-88.

Keywords: Experience, Parents and home, Stereotypes and bias, Outside U.S.

222 Israeli students in grades 8-10 in schools where computers had not yet been introduced were surveyed about their computer experience and attitudes. Prior computer exposure, and in particular having a computer at home, had a stronger effect on attitudes toward computers than sex. Boys held more gender-stereotyped attitudes about who is capable of using computers and had more positive attitudes toward the computer as a medium of instruction than girls.

Levine, Tamar, and Smadar Donitsa-Schmidt. "Computer Experience, Gender, and Classroom Environment in Computer-Supported Writing Classes." Journal of Educational Computing Research 13.4 (1995): 337-57.

Keywords: Experience, Context, Outside U.S.

951 10th and 11th grade students in Israel took a writing class, about two-thirds with a computer and the rest without. Boys in both groups owned computers more than girls and were therefore more likely to use word processing. Gender differences in perceptions of classroom environment were not affected by whether boys and girls were in a computer-supported or traditional writing class.

Lewis, Linda. Closing the Skills Gap: Maximizing Options for Females and Minorities. Hartford CT: Connecticut Project on Equal Education Rights, 1984.

Keywords: Early work, Enrollments

A report on the computer gender gap in Connecticut. At the time, girls were 44% of those taking Computer Science 1 and 38% of those taking CS 2.

Liao, Yuen-kuang Cliff. "Gender Differences on Attitudes toward Computers: A Meta-Analysis." Society for Information Technology and Teacher Education International Conference. San Antonio TX: ERIC ED 432 287, 1999.

Keywords: Attitudes and expectations, Research review

A meta-analysis was done of 106 studies (about 1/4 on non-USA subjects) on attitudes towards computers by gender published between 1984 and 1997 via three sources: ERIC, Dissertation Abstracts, and branching from bibliographies. Attitudes examined in the studies were anxiety, belief in usefulness, confidence, liking, ability-related stereotype, and sex-related stereotype. "... overall, male subjects had slightly higher computer attitudes than female subjects." p. 5 "It is possible [that] because male subjects hold higher sex-related stereotypes toward computer use, ... this tendency influences female subjects' feelings about computers that results in females' overall more negative attitudes toward computers." (p. 6)

Lim, G., and M. Wang. "A Study of Academic Performance of Male and Female Students in a Computer Course." Action for Equity: The Second Decade. Ed. Leonie J. Rennie. Perth, Australia: National Key Centre for School Science and Maths, Curtin University of Technology, 1991. Keywords:

Could not obtain: not reviewed.

Lindia, S., and S.V. Owen. "A Computer-Intensive Program as a Moderator of Group and Gender Differences in Sex-Role Socialization, Self-Efficacy, and Attitudes toward Computers." New England Educational Research Organization. Portsmouth, NH, 1991.

Could not obtain: not reviewed.

Linn, Eleanor. "Gender Equity and Computer Technology." Equity Coalition 5 (1999): 14-17.

Keywords: Attitudes and expectations, Software, Telecommunications, Language and terminology

Explores female computer avoidance on the basis of the computer as a machine, associated strongly with males. Also talks about sexist and violent computer terminology: abort, hits, permanent fatal errors, servers named Choplifter and Battlezone. Software for girls "perpetuate[s] sexism and serve[s] only to enrich the companies that produce them." (p. 16). Discussion of how technology can expand children's gender roles: good games and gender-anonymous telecommunications.

Linn, Marcia C. "Assessing the Cognitive Consequences of Computer Environments for Learning." Sex Roles: A Journal of Research 13.3/4 (1985): 229-40.

Keywords: Programming, Access, Early work,

The ACCEL Project examined student performance in BASIC programming courses at six middle schools, where two thirds of the students enrolled in the class were male. Girls did as well as or

better than boys on the final assessment. Increasing access to computers should resolve the gender discrepancy.

---. "Fostering Equitable Consequences from Computer Learning Environments." Sex Roles: A Journal of Research 13.3/4 (1985): 229-40.

Keywords: Programming, Enrollments

In a study of 525 middle-school students, girls comprised about 40% of the students in programming (BASIC) courses, performed as well as or better than males, and comprised 60% of the most talented students. The conclusion is that females and males perform similarly once they enroll in programming courses, so the goal should be to increase female enrollment.

---. "Gender Equity in Computer Learning Environments." Computers and the Social Sciences?1 (1985): 19-27.

Could not obtain: not reviewed.

---. "Technology and Gender Equity: What Works?" Women in Science and Technology. Eds. Nancy Felipe Russo, Connie Chan, Mary Beth Kenkel, Cheryl B. Travis and Melba Vasquez. New York: American Psychological Association, 2005.

Keywords: Extracurricular programs, Parents and home, Games, Experience, Retention, Classroom interactions, Telecommunications, Role models and mentors, Critical mass, Stereotypes and bias, Stereotype threat, Teachers and faculty, Curriculum

This chapter describes techniques for infusing technology throughout formal and informal education, and strategies for neutralizing cultural factors that discourage the participation and persistence of women in technological endeavors. Students can gain more technology access in a weekend at home than in a year at school. Games are male-oriented. In school, computer use for complex projects favors males because it's likelier to occur in advanced computer science, math and science courses in high school and engineering in college, where more males are enrolled. Prior experience with repairing cars, thinking about spatially presented info, or using computers makes a difference. At Berkeley a graphical communication course specifically tries to augment spatial skills; it was successful with females which aided their retention. Asynchronous online discussions equalize contributions by males and females, especially if monitored. Role models help. Critical mass: MIT compensated for women's lower test scores by changing its admissions standards: more women there then raised standards overall. Stereotypes decrease females' performance via stereotype threat and "priming." Recommendations: infuse technology across curriculum, modify instruction to promote equity.

Lips, Hilary M., and Linda Temple. "Majoring in Computer Science: Causal Models for Women and Men." Research in Higher Education 31.1 (1990): 99-113.

Keywords: Enrollments, Experience, Pipeline, Attitudes and expectations, Mathematics, Career factors

Four factors are involved in choosing computing: interest in it and enjoyment of it, comfort or confidence with it, confidence in one's mathematical ability, and amount of computer experience. 311 undergrad students in introductory psychology and sociology courses completed a questionnaire. For males, interest and enjoyment of computers was predicted by math confidence, whereas for females it was predicted by computer experience.

Littleton, Karen, and Maria Bannert. "Situating Differences: The Case of Gender and Computer Technology." Learning Sites: Social and Technological Resources for Learning. Eds. Joan Bliss, Roger Saljo and Paul Light. New York: Pergamon, 1999. 171-82. Keywords:

Could not obtain: not reviewed.

Littleton, Karen, and Celia Hoyles. "The Gendering of Information Technology." Ghosts in the Machine: Women's Voices in Research with Technology. Eds. Nicola Yelland and Andee Rubin. New York: Peter Lang Publishing, Inc., 2002. 3-32.

Keywords: Curriculum, Single-sex environment, Role models and mentors, Research review

Three developmental stages in IT curriculum with respect to gender: Stage 1: noticing the absence of females — imbalances in computer use in school and at home, attitudes toward computer use, computing ability (not an issue). Stage 2: changing female participation in IT activities — role models, mixed-sex groupings (single sex not a long-term solution) and collaborative work. Stage 3: challenging the dominant paradigm of IT use in schools — epistemological pluralism, embedding technology in the curriculum, challenging the paradigm.

Littleton, Karen, Paul Light, Richard Joiner, David Messer, and Peter Barnes. "Gender, Task Scenarios and Children's Computer-Based Problem Solving." Educational Psychology 18.3 (1998): 327-40.

Keywords: Software, Stereotypes and bias, Outside U.S.

11- and 12-year-old children in the UK were randomly given two versions of route-planning software. Half of the boys succeeded in each version, but girls were much more likely to succeed in an adventure game in the "Honeybears" version which draws on ideas from the nursery song "The Teddy Bears' Picnic" than they were in the "King and Crown" version (the retrieval of crown involves getting driving, sailing or flying to a feast and pirates). The two were structurally identical. A second study presented a new version of "King and Crown" entitled "Pirates" and the same "Honeybears" version. Same result: boys' performance did not vary by version, but girls' performance was far superior for the "Honeybears" version. Conclusion: "superficial software 'versioning' can indeed dramatically transform the pattern of gender differences in performance." (p. 337)

Littleton, Karen et al. "Gender and Software Effects in Children's Computer-Based Problem Solving." Educational Psychology 7 (1998): 327-40.

Could not obtain: not reviewed.

Littleton, K. et al. Gender and Software Interactions in Children's Computer-Based Problem Solving: ESRC Centre for Research in Development, Instruction and Training, 1994.

Could not obtain: not reviewed.

---. "Paring and Gender Effects on Children's Computer-Based Learning." European Journal of Psychology of Education 7 (1992): 311-24.

Could not obtain: not reviewed.

Liu, Min, W. Michael Reed, and Perry D. Phillips. "Teacher Education Students and Computers: Gender, Major, Prior Computer Experience, Occurrence, and Anxiety." Journal of Research on Computing in Education 24.4 (1992): 457-67.

Keywords: Experience, Programming, Attitudes and expectations

914 teacher education students filled out questionnaires including questions on computer use. Males had slightly less prior computer experience than females but also less computer anxiety, which was correlated with programming experience (which males had more of).

Lockheed, Marlaine E. "Women, Girls, and Computers: A First Look at the Evidence." Sex Roles: A Journal of Research 13.4 (1985): 115-22.

Keywords: Early work

Males used computers more than females for programming and game-playing, not more for other computer applications in which the computer was a tool. Cognitive effects were similar for both sexes.

Lockheed, Marlaine E., Antonia Nielsen, and Meredith Stone. "Sex Differences in Microcomputer Literacy." National Educational Computer Conference. Baltimore, 1983.

Keywords: Early work, Extracurricular programs, Secondary/high school, Use patterns

High school students in a computer literacy class were given a test at the first and final sessions. No initial gender differences in computer literacy were found, but boys gained more than girls by the post-test. Males reported more frequent use of computers and more positive attitudes than females. More males than females planned to take a computer course in the future. Out-of-school access was greater for boys than girls, and related to computer literacy gains for girls but not for boys. After-school use of the computer center was related to computer literacy gains for boys but not for girls. Computer game-playing was unrelated to computer literacy gains for everyone.

Lovegrove, Gillian, and Wendy Hall. "Where Are the Girls Now?" Women into Computing: Selected Papers, 1988-1991. Eds. Gillian Lovegrove and Barbara Segal. London: Springer Verlag, 1991.

Keywords: Interventions, Critical mass, Enrollments, Curriculum, Programming, Postsecondary/tertiary, Outside U.S.

To counteract falling female enrollments in university computer science programs, they recommend that schools: make courseware interesting to girls, make computers an ordinary classroom resource in primary and secondary schools, and make it easier for girls to choose IT electives. Universities should hold open days for schoolchildren, consciously aimed at girls as well as boys, to make it clear that CS is more than programming; have role models, have an anti-discrimination policy, exercise care to retain enrolled women, put girls in the same tutorial groups (critical

mass), and have tutors be unusually supportive. At the University of Southampton the problem was too few female applicants, but those who did apply registered at the same rate as the males.

Loyd, B.H., and D.E. Loyd. "Computer Attitudes: Differences by Gender and Amount of Computer Experience." American Educational Research Association. New Orleans, 1988.

Could not obtain: no review.

Loyd, Brenda H., Douglas E. Loyd, and Clarice P. Gressard. "Gender and Computer Experience as Factors in the Computer Attitudes of Middle School Students." Journal of Early Adolescence 7.1 (1987): 13-19.

Keywords: Attitudes and expectations, Experience, Middle school

561 7th and 8th graders were studied. Greater computer experience was found to be significantly related to less anxiety and greater liking of computers. Female students exhibited more positive attitudes than male students toward the use of computers at lower computer-experience levels. (Nothing here on whether males had more experience than females, but other research establishes this.)

Lupart, Judy L., and M. Elizabeth Cannon. "Gender Differences in Junior High School Students Towards Future Plans and Career Choices." Canadian Coalition of Women in Engineering, Sciences, Trades, and Technology, 2000.

Keywords: Attitudes and expectations, Career factors, Use patterns, Outside U.S., Middle school

585 7th grade students in Calgary were surveyed about computer use and liking. There was no sex difference in home computer ownership or age when they started using computers. However, males liked computers significantly more than females and rated their skill level higher. Males spent significantly more time using computers. Game-playing came in first, especially for males; second for girls was homework uses but for boys it was surfing the Net. Asked about future career preferences, girls were most likely to choose artistic careers while boys were most likely to choose IT careers; 59% of the boys but 25% of the girls expressed interest in IT careers.

Madison, Sandra, Min Deng, and James Gifford. Creating Gender Equitable Computer Classrooms: A Model Project, 1999.

Keywords: Extracurricular programs, Secondary/high school, Teacher education

Project FOCAL Point gave 7 high school computer teachers a two-week workshop on computer skills and gender equity for graduate credit, a one-week computer camp for high school girls in the second teacher week, mini-grant projects, a follow-up conference, and listservs for teachers and students. At the end of the two-week session, participants rated it positively.

Mahony, Rhona. "Women at Work, Girls at Play." Ms. January/February 1997: 37-40.

About Girl Tech, headed by Janese Swanson, maker of electronic games for girls.

Makrakis, Vasilios. "Cross-Cultural Comparison of Gender Differences toward Computers in Japan and Sweden." Scandinavian Journal of Educational Research 36.4 (1992): 275-87.

Keywords: Attitudes and expectations, Cross-cultural, Mathematics, Outside U.S., Secondary/high school

773 9th graders in Japan and Sweden were given a questionnaire. There was a significant main effect for country, with Swedish students having more gender-equitable attitudes and less association of computers with math or science. The country effect held more strongly for female than male students. Japanese females held stronger beliefs about the necessity for computers and interest in computers than Swedish females, perhaps reflecting Japan's role as a technological power. Japanese males and females were likelier to hold gender-stereotyped impressions than Swedish males and females. Swedish boys were likelier to hold gender stereotypical beliefs than Swedish girls. Both Japanese and Swedish boys held higher computer skill necessity attitudes than the girls. Japanese and especially Swedish boys had more interest in learning about computers than girls. Overall, there were relatively few gender differences among Japanese students and more among Swedish students. Culture and gender explained more of the difference in computer attitudes than computer ownership, peer influence, or teacher or parental encouragement. "[A] gender-biased society teaches girls to have gender stereotyped interests." (p. 285)

---. "Gender and Computing in Schools in Japan: The "We Can, I Can't" Paradox." Computers and Education 20.2 (1993): 191-98.

Keywords: Outside U.S., Secondary/high school, Attitudes and expectations, Teachers and faculty

Ninth-grade Japanese students were given an attitude questionnaire. There were no significant gender differences in computer self-efficacy. However, there were for computer usefulness, prior experience, and teacher encouragement, all favoring males. Girls showed a distinct "I can't but

we can" belief set, possibly related to the Japanese value on group as opposed to individual. For girls, computer usefulness most strongly predicted self-efficacy, while for boys it was occupational aspirations.

Makrakis, Vasilios, and Toshio Sawada. "Gender, Computers and Other School Subjects among Japanese and Swedish Students." Computers and Education 26.4 (1996): 225-31.

Keywords: Cross-cultural, Attitudes and expectations, Mathematics, Outside U.S.

About 1,000 9th graders from Tokyo and Stockholm were surveyed. In both countries, males reported higher scores for usefulness, aptitude, and liking of computers, and more positive attitudes toward math and science than girls. Girls consistently reported that the subjects they liked least were computers, math and science.

Mandinach, Ellen B., and Marcia C. Linn. "Cognitive Consequences of Programming: Achievements of Experienced and Talented Programmers." Journal of Educational Computing Research 3.1 (1987): 53-72.

Keywords: Programming, Access

Teachers and students nominated students who could write a simple program on their own. Of the 98 students nominated, 54% were male and 46% female. This group was given a programming test, which a quarter of the group passed. In this subsample, 37% were male and 63% were female: females were over-represented among the most talented. No significant gender differences were found on any of the measures of programming performance, computer access, or ability. "[G]iven the opportunity, females are especially likely to succeed in acquiring programming expertise." (p. 67) General ability was not related to programming performance.

Manes, Stephen. "Alice's Adventures in Boredomland." New York Times October 7 1997.

Keywords: Software

Software programs for girls are reviewed: saccharine, boring, and stereotyped.

Mangione, Melissa. "Understanding the Critics of Educational Technology: Gender Inequities and Computers 1983-1993." Association for Educational Communications and Technology. Anaheim, CA, 1995.

Keywords: Software, Culture, Access, Use patterns, Stereotypes and bias, Research review, Race, ethnicity, or SES, Mathematics

A ten-year review of research on the content and design of software with respect to gender and race and usage patterns. Gender bias occurs from the origins of computing in math and science, both male domains.

Margolis, Jane, and Allan Fisher. "Geek Mythology and Attracting Undergraduate Women to Computer Science." Impacting Change Through Collaboration: Joint National Conference of Women in Engineering Programs Advocacy Network (WEPAN) and the National Association of Minority Engineering Program Administrators. Crystal City, MD, 1997.

Keywords: Culture, Attitudes and expectations, Stereotypes and bias, Pedagogy,

The male culture of computing.

---. Unlocking the Clubhouse: Women in Computing. Cambridge, MA: MIT Press, 2002.

Keywords: Culture, Teacher education, Attitudes and expectations, Experience, Middle school, Secondary/high school, Role models and mentors, Departmental change, Outside U.S.

Book explores dimensions of the computer gender gap in terms of families' computer-related behaviors; primary, secondary, and postsecondary classrooms; the male culture of computer science; influences on persisting vs. dropping out; the different responses of American vs. international women; and recommendations for change.

---. Women in Computer Science: Closing the Gender Gap in Higher Education, 2000.

Keywords: Postsecondary learning & achievement, Retention, Enrollments, Experience, Attitudes and expectations, Interventions, Culture

Experience pp. 6-7. Suggestions for interventions pp. 7-8. Erosion of confidence precedes loss of interest.

Margolis, Jane, Allan Fisher, and Faye Miller. "The Anatomy of Interest: Women in Undergraduate Computer Science." Women's Studies Quarterly 28.1/2 (2000): 104-27.

Keywords: Attitudes and expectations, Retention, Stereotypes and bias, Experience, Role models and mentors, Outside U.S.

They "focus on the process by which students who enter with high enthusiasm and interest in computing quickly lose their faith in the ability and their interest in the subject." (p. 1) Women feel they know so much less than the men. The "nexus of confidence and interest." (p. 7) The

pattern for international women is different, who enter with less experience and interest than American women but persist anyway. Faculty mentors are important to women.

---. "Caring About Connection: Gender and Computing." IEEE Technology and Society Magazine 18.4 (1999): 13-20.

Keywords: Culture, Curriculum, Context, Retention, Use patterns, Programming, Postsecondary/tertiary

The paper explores ways the computer science curriculum gives prestige to the male approach to computing but devalues women's approach. Women entered Carnegie Mellon University's School of Computer Science enthusiastic about computers and programming, often with the orientation of serving others. Men find the machine itself fascinating and want to figure out how it works, endlessly. Women struggle to maintain their interest in this environment. When they compare their source of attachment to computing to men's, their self-confidence erodes: they must be doing it wrong. They don't "dream in code." Curriculum reinforces the male orientation, with the early years highly technical, narrowly focused on programming, and devoid of social context. They recommend several ways to change the curriculum to include more of women's interests (p. 18).

---. Computing for a Purpose: Gender and Attachment to Computer Science. (n.d.) http://www-2.cs.cmu.edu/~gendergap/purpose.html, retrieved November 8, 2004

Keywords: Culture, Programming, Parents and home, Curriculum

Women "are more likely to place a high value on the context of computing, the links between computers and other fields, and the contribution to society that computers can make." (p. 1) Male students mentioned their fathers, not mothers, in early computing experiences, and enjoy programming to control the machine.

---. Failure Is Not an Option: International Women in Computer Science. (n.d.) http://www-2.cs.cmu.edu/~gendergap/intwomen.html

Keywords: Retention, Experience, Attitudes and expectations, Cross-cultural

International women have less prior computing experience and interest in computing than American women, but they persist more because of economic and pragmatic realities.

---. Geek Mythology. (n.d.) http://www-2.cs.cmu.edu/~gendergap/geekmyth.html, retrieved December 10, 2004

Keywords: Culture, Attitudes and expectations, Curriculum, Pedagogy, Retention

Discusses the geeky culture of computing and how it doesn't suit females.

---. Living among The "Programming Gods": The Nexus of Confidence and Interest for Undergraduate Women in Computer Science. (n.d.) http://www-2.cs.cmu.edu/~gendergap

Keywords: Attitudes and expectations, Programming, Retention, Stereotypes and bias, Stereotype threat, Interventions, Pedagogy, Culture

The link between loss of confidence in one's computing ability and loss of interest in it as a field of study or career. Interventions included creating multiple entry-level courses and an overview course to help students see a more complete picture of the field, pedagogical changes, faculty mentors, and explicit attention to the culture.

Mark, June. "Beyond Equal Access: Gender Equity in Learning with Computers." Women's Educational Equity Act Publishing Center Digest (1992).

Keywords: Research review

Brief review of research on factors of importance to teachers.

Markoff, John. "Computing in America: A Masculine Mystique." New York Times February 13 1989: 1A.

Keywords: Culture

Article and responding letters to the editor about the male computer culture.

Martin, C. Dianne, and Eric Murchie-Beyma, eds. In Search of Gender-Free Paradigms for Computer Science Education. Eugene OR: International Society for Technology in Education, 1992.

Keywords: Research review, Interventions, Culture

Collection of chapters: power of paradigms, research findings, strategies for change, gender equity resources.

Martin, R. "School Children's Attitudes Towards Computers as a Function of Gender, Course Subjects, and Availability of Home Computers." Journal of Computer Assisted Learning 7 (1991): 187-94.

Keywords: Attitudes and expectations, Parents and home

15-year-old students in England were surveyed. Males had more positive computer attitudes. Home ownership of a computer was correlated with boys' taking a computer-related class in school more strongly than it was for girls.

Martin-McCormick, Lynda, Jennifer Tucker, Teresa Layton Hellinger, and Leslie R. Wolfe. Programming Equity into Computer Education: Today's Guide to the Schools of the Future. Washington DC: Project on Equal Education Rights, NOW Legal Defense and Education Fund, 1985.

Keywords: Software, Career factors, Teacher education, Extracurricular programs, Attitudes and expectations, Early work

Contains needs assessment questions.

Maxwell, D. Jackson. "Technology and Inequality with the United States School Systems." Journal of Educational Thought 34.1 (2000): 43-57.

Keywords: Race, ethnicity, or SES, Experience

Students are not afforded equal opportunities to acquire computer skills on the basis of gender, geographical location, and race.

Mayer-Smith, Jolie, Erminia Pedretti, and Janice Woodrow. "Closing of the Gender Gap in Technology Enriched Science Education: A Case Study." Computers and Education 35 (2000): 51-63.

Keywords: Pedagogy

Both male and female high school students in British Columbia preferred learning science with technology. In interviews they mentioned aspects of pedagogy — self-pacing, flexibility, choice of activity, self-monitoring, and working with peers — that made them like their science class, but did not mention the technology. Both boys and girls reported a high degree of comfort with the computers in the classroom.

McCormick, Naomi, and John McCormick. "Not for Men Only: Why So Few Women Major in Computer Science." College Student Journal 25 (1991): 345-50.

Keywords: Age, Games, Culture, Media, Stereotypes and bias, Interventions, Teachers and faculty, Curriculum

Female disengagement with computers starts early and increases with age due to computer games, the male computer culture, mass media, and sex-role stereotypes. In college, the computer lab culture is problematic and women find the introductory computer course alienating. To encourage women to study CS, improve campus security after dark, recognize talented women's talent, involve undergrad women in research, make the lab more feminine (less untidy and unattractively furnished), more gender-sensitive computer lab assistants and peer tutors, reduce sex bias in software, assignments, and curricula, and design learning experiences that appeal to women's social and ethical interests.

McCoy, Leah P., and Tina L. Heafner. "Effect of Gender on Computer Use and Attitudes of College Seniors." Journal of Women and Minorities in Science and Engineering 10.1 (2004): 55-66.

Keywords: Use patterns, Attitudes and expectations, Postsecondary/tertiary

At Wake Forest all freshmen are issued laptops and use them throughout the four years. Students were studied about computer use and attitudes. "When the technological environment was institutionally equalized for male and female students, many traditional findings of gender differences were not evident." (p. 55) Male students were more likely to rate themselves as highly skilled at computers than females. Males used the computer more for resources and entertainment than females. Overall, use and attitude measures were similar for males and females.

McCoy, Leah P., Tina L. Heafner, Matthew G. Burdick, and Laura M. Nagle. "Gender Differences in Computer Use and Attitude on a Ubiquitous Computing Campus." American Educational Research Association. Seattle, 2001.

Keywords: Use patterns, Attitudes and expectations, Access, Postsecondary/tertiary

Seniors at Wake Forest University were surveyed about their computer use and attitudes at the end of their 4th year on a computer-intensive campus. Males and females used the computer equally often as a tool, for resources, and for communication. Males used the computer somewhat more than females for entertainment. Attitudes about computers did not vary by gender, although males rated their expertise as higher. Conclusion: "This study indicates a 'leveling' effect when males and females have equal computer access."

McGlone, Matthew S., and Joshua Aronson. "Stereotype Threat and the Gender Gap in Political Knowledge." Public Opinion Quarterly (In press).

Keywords: Stereotype threat

In a telephone survey of political and civics knowledge, women's accuracy level dropped in relation to men's when the interviewers were male and when they were told the test was sensitive to gender

differences (= stereotype threat condition). Men's response accuracy was unaffected by the sex of the interviewer and the stereotype threat condition.

McGrath, Diane, Linda P. Thurston, Hilary McLellan, Darla Stone, and Marsha Tischhauser. "Sex Differences in Computer Attitudes and Beliefs among Rural Middle School Children after a Teacher Training Intervention." Journal of Research on Computing in Education 24.4 (1992): 468-85.

Keywords: Race, ethnicity, or SES, Teacher education, Parents and home, Middle school

17 rural middle school teachers were given training in computer education and gender equity. Their students and students of control-group teachers were studied about their attitudes about gender appropriateness of five subjects. There were no differences in these attitudes, but control-group students, both male and female, reported liking computers, math, and science more. More boys than girls owned home computers, and used them more.

McIlroy, D., B. Bunting, K. Tierney, and M. Gordon. "The Relation of Gender and Background Experience to Self-Reported Computing Anxieties and Cognitions." Computers in Human Behavior 17.1 (2001): 21-33.

Keywords: Methodology, Attitudes and expectations, Postsecondary/tertiary, Outside U.S.

An attitude questionnaire was given to undergraduate social science majors in Northern Ireland. Gender differences in computer attitudes may be more identifiable if responses are examined at the factor level rather than scale level, which may conceal them. A factor "microanalysis" turned up conflicting gender directions on various attitude measures.

McKenzie, Jamieson. The Computer Gender Gap: A Princeton up-Date. (1985) Unpublished manuscript.

Keywords: Early work, Attitudes and expectations, Parents and home, Teachers and faculty

Boys rated their comfort level with computers more highly than girls did. The gap between boys and girls reporting high comfort widened in a second year despite district efforts to narrow it. Boys' and girls' comfort level with the computer was independent of the teachers' sex. Teachers rated students' skill levels higher for students who had computers at home, primarily boys. Students relied on fathers and brothers more for computer help at home.

McNair, Shannan, Anna Korova-Petrova, and Ambika Bhargava. "Computers and Young Children in the Classroom: Strategies for Minimizing Gender Bias." Early Childhood Education Journal 29.1 (2001): 51-55.

Keywords: Interventions, Role models and mentors, Software, Classroom interactions

Among strategies recommended for minimizing gender bias in classroom computer use are role models, anti-bias teaching strategies, and bias-free software.

McNees, Pat. New Formulas for America's Workforce: Girls in Science and Engineering. Arlington, VA: National Science Foundation, pub. # NSF 03-207, 2003.

Keywords: Interventions, Middle school, Secondary/high school, Postsecondary/tertiary, Teacher education, Extracurricular programs, School programs

Describes over 250 projects on girls in science, technology, engineering, and mathematics (STEM) funded by the National Science Foundation. Excellent index for identifying interventions. Pp. 101-113 list 16 projects on girls and IT carried out with funding from the Program for Gender Equity, for girls from middle school through college and for teachers.

Melymuka, Kathleen. "If Girls Don't Get It, It Won't Get Girls." ComputerWorld January 8 2001.

Keywords: Barriers, Attitudes and expectations

Girls aren't interested in IT because corporate America and the technology community have been doing a lousy public relations job.

MentorNet. Mentornet. n.d. Website. Available: http://www.mentornet.net, retrieved December 28, 2004.

Keywords: Role models and mentors

Electronic mentoring program for young women in technology and the sciences, in operation since 1998.

Millard, Elaine. "New Technologies, Old Inequalities: Variations Found in the Use of Computers by Pupils at Home with Implications for the School Curriculum." British Educational Research Association. University of York, UK, 1997.

Keywords: Parents and home, Attitudes and expectations, Outside U.S.

They surveyed Year 7 and Year 9 students in Northern England at schools with varying SES levels. 56% of boys but only 22% of girls said they had computers in their rooms at home; the imbalance was even greater in inner-city homes. Boys used computers much more than girls, mostly for games. Boys estimated their computer competence more highly than girls. Schools must recognize and counteract these imbalances.

Miller, Leslie, Melissa Chaika, and Laura Groppe. "Girls' Preferences in Software Design: Insights from a Focus Group." Interpersonal Computing and Technology 4.2 (1996): 27-36.

Keywords: Software, Career factors

Cites a dissertation by Yasmin Kafi in which 4th grade students were asked to design a game to teach fractions by programming in LOGO; boys and girls chose different themes, rewards, and feedback for wrong answers. In the study in this paper, 30 girls from grades 6-12 discussed and explored software for 6 hours. Half had little to no experience with computers. Girls preferred to ask each other for help with software rather than using a manual. They placed a high value on the quality of the visual and audio design, preferred that software be collaborative rather than competitive and were interested in role-playing associated with careers.

Miller, Leslie M., Heidi Schweingruber, and Christine L. Brandenburg. "Middle School Students' Technology Practices and Preferences: Re-Examining Gender Differences." Journal of Educational Multimedia and Hypermedia 10.2 (2001): 125-40.

Keywords: Access, Use patterns, Attitudes and expectations, Parents and home, Telecommunications, Games, Race, ethnicity, or SES, Middle school

512 middle-school students were surveyed in Houston public and private schools. The only significant gender difference was in self-report of expertise, with boys claiming more. They found no gender difference in home computer ownership, though boys used a home computer more often. Mothers and fathers used the home computer equally according to both boys and girls. There were no gender differences in school computer use. There were some gender differences in Web style, content, and activity preferences and in types of computer games played. Computer use by gender and SES is equalizing due to greater equality of use at home, school, and of the Internet.

MIT Computer Science Female Graduate Students and Research Staff. Barriers to Equality in Academia: Women in Computer Science at MIT. Cambridge, MA: Laboratory for Computer Science, MIT, 1983.

Keywords: Culture, Males, Attitudes and expectations, Stereotypes and bias, Postsecondary/tertiary, Early work

Describes problems for women in IT caused by the male culture of computing: invisibility, patronizing behavior, overemphasis on qualifications, limits on acceptable behavior, obscenity, unwanted attention, etc.

MIT Department of Electrical Engineering & Computer Science. Women Undergraduate Enrollment in Electrical Engineering and Computer Science at MIT. Cambridge, Massachusetts: MIT, 1995.

Keywords: Experience, Culture, Critical mass, Postsecondary/tertiary

In two surveys of MIT undergraduates in EECS (Electrical Engineering and Computer Science), women felt less prepared than men. Most males and females agreed the major was very competitive. Recommendations include offering a new introductory course for students with little or no CS experience, and scheduling women into a critical mass in classes.

Mitra, Ananda, Stefne Lenzmeier, Timothy Steffensmeier, Rachel Avon, Nancy Qu, and Mike Hazen. "Gender and Computer Use in an Academic Institution: Report from a Longitudinal Study." Journal of Educational Computing Research 23.1 (2000): 67-84.

Keywords: Attitudes and expectations, Use patterns

In a computer-rich environment where all students had networked access and laptops over four years, it was found that women were less positive about computers than men and used them less. This seems to be a "throwback to the earlier days of computing." (Reviewed abstract only)

Miura, Irene T. "Gender and Socioeconomic Status Differences in Middle-School Computer Interest and Use." Journal of Early Adolescence 7.2 (1987): 243-54.

Keywords: Peers and friends, Attitudes and expectations, Mathematics, Race, ethnicity, or SES, Middle school

It is important to consider SES as well as gender, because it was found that SES mediated gender differences. 236 7th graders in low- and high-SES schools in California were studied. Both groups were taught BASIC by a female math teacher in a computer lab. Siginificant gender main effects were found for perceived self-efficacy and perceived peer reactions to computer involvement. Significant gender X SES interactions were found for interest in learning about computers, willingness to consider a computer-related career, liking for the computer, math interest, and math achievement. Low SES females indicated a greater interest in computers and more willingness to consider a computer-related career than high SES females.

---. "The Relationship of Computer Self-Efficacy Expectations to Computer Interest and Course Enrollment in College." Sex Roles: A Journal of Research 16.5/6 (1987): 303-11.

Keywords: Attitudes and expectations, Programming, Parents and home

Undergraduates completed a questionnaire about their computer self-efficacy (defined as "the belief that one can successfully execute a certain course of behavior," p. 304). Men rated themselves higher. The main predictor of computer self-efficacy for women was having taken programming in high school, as well as computer ownership.

---. "Understanding Gender Differences in Middle School Computer Interest and Use." American Educational Research Association. San Francisco, 1986.

Keywords: Middle school, Attitudes and expectations, Role models and mentors

Middle school students were surveyed over three years. Despite a decline over time, boys were more involved in computers throughout, possibly because they had more opportunities for mastery, more role models, greater verbal encouragement, and less fear of machines. Boys expressed a more positive attitude of the benefits of computers to society. (Reviewed abstract only)

Miura, Irene T., and Robert D. Hess. "Sex Differences in Computer Access, Interest and Usage." American Psychological Association. Anaheim, 1983.

Keywords: Parents and home, Extracurricular programs, Early work, Software

Three studies on home computer ownership, computer camps, and sex typing in software. 1) Boys were the heaviest users of home computers; mothers not at all. 2) In summer computer camps, girls' participation dropped with the level of computer class offered and as the cost of the camp increased. 3) Middle-school students were asked to rate randomly chosen software titles (from education, entertainment, and general interest) for perceived user interest: titles were seven times more likely to be considered of greater interest to males than females, by both girls and boys.

Mohor, M. , and D. Sturm. "Gender and Computer Science Majors: Perceptions and Reality." National Educational Computing Conference, 1995.

Could not obtain: not reviewed.

Moore, B.G. Equity in Education: Gender Issues in the Use of Computers. Toronto: Ontario Institute for Studies in Education, 1986.

Could not obtain: not reviewed.

Morahan-Martin, J., A. Olinsky, and P. Schumacher. "Gender Differences in Computer Experience, Skills, and Attitudes among Incoming College Students." Collegiate Microcomputer 10 (1992): 1-8.

Could not obtain: not reviewed.

Morrell, Claudia, Shelia Cotten, Alisha Sparks, and Alyson Spurgas. Computer Mania Day: An Effective Intervention for Increasing Youth's Interest in Technology: Center for Women & Information Technology, University of Maryland/Baltimore, 2004.

Keywords: Interventions, Race, ethnicity, or SES, Middle school, Career factors, Role models and mentors, Culture, Extracurricular programs, Attitudes and expectations

Report on a half-day of technology-related activities for over 300 6th through 8th grade girls and their parents and teachers. Pre/post surveys indicated that participation positively influenced girls attitudes about technology in general, the usefulness of computers and technology, and about women's involvement in technology. They said they were more likely to take a computer course and consider a computer career. The effect was stronger for girls of color than white girls. Reasons for girls' under-representation: lack of role models and male-dominated culture. On C.M. Day there were sessions taught by role models

Morse, Frances K., and Colette Daiute. "I Like Computers Versus I Likert Computers: Rethinking Methods for Assessing the Gender Gap in Computing." American Educational Research Association. San Francisco, 1992.

Keywords: Research review, Attitudes and expectations, Mathematics, Secondary/high school, Methodology

This paper critically examines research results in terms of:

(a) methodological issues (inconsistent definitions of "attitude," "aptitude," and "usage" across studies; insufficient statistical rigor,

(b) measurement instrument formats (does midpoint in Likert scale mean Neutral or Don't Know or No Opinion or Unsure; difficult to answer without context),

(c) controversies regarding attitude research (difficulty in finding attitude measures that correlate with overt behavior; incorrect to assume that attitudes always precede behavior),

(d) feminist perspectives (computer as male machine),
(e) underlying assumptions about the computer (meaning of word "computer" changes with its uses; questionable association with mathematics), and
(f) insufficient contextual details (too much focus on the machine and not enough on the context).
Study: observed multimedia class in suburban high school, asked kids open-ended questions about what they thought of the software they used. Overall girls were positive and enthusiastic about computing, not anxious, uninterested, or avoidant.

Moses, L.E. "Our Computer Science Classrooms: Are They "Friendly" To Female Students?" SIGCSE Bulletin 25.3 (1993): 3-13.
Keywords: Postsecondary/tertiary, Interventions, Role models and mentors, Pedagogy
Recommends improving the physical environment of computing (e.g. clean, well lit, etc.), less isolated learning environment in class, group work, more time for assignments, and role models.

Moskal, Barbara. "Female Computer Science Doctorates: What Does the Survey of Earned Doctorates Reveal?" SIGCSE Bulletin 34.2 (2002): 105-11.
Keywords: Postsecondary/tertiary, Career factors,
Article compares data on females completing doctorates in CS between 1990-91 and 1999-2000. The percent of women rose slightly from about 14% to about 17%. At this rate, "In computer science, parity with men will not be reached until the academic year 2087-2088." (p. 106) Women spent more time in graduate school than men and were more likely to rely upon personal support to fund their education than men. Though women had the advantage in scholarships and teaching assistantships, males had a greater advantage in research assistantships and internships which outweighed the female advantage with respect to primary source of funding. After graduation, women were more likely to enter academic positions and men more likely to enter industry positions.

Mounfield, L., and H. Taylor. "Exploration of the Relationship between Prior Computing Experience and Gender on Success in College Computer Science." Journal of Educational Computing Research 11.4 (1994): 291-306.
Could not obtain: not reviewed.

Muller, Joann. "Virtual Equality? Software Firms Find New Niche: Games for Girls." Boston Sunday Globe 1998: 1.
Keywords: Software
Software for girls is "girly" because the market targets boys.

Mumtaz, Shazia. "Children's Enjoyment and Perception of Computer Use in the Home and the School." Computers and Education 36 (2001): 347-62.
Keywords: Parents and home, Use patterns, Attitudes and expectations, Pedagogy, Extracurricular programs, Elementary/primary, Outside U.S.
Children in years 3 and 5 in England were studied about computer use at home and at school. Children made more use of home computers than school computers. Boys used home computers most for playing games, girls for emailing friends. Boys spent more time on home computers than girls. School computers were used most for word processing, which children considered boring, and ICT has therefore come to be associated with applications, a negative attitude. "Boys were more confident about using computers at home and at school, and rated themselves better at using computers." (p. 358) Both boys and girls benefit from using home computers but boys benefit more, perhaps because they use it for more time. Teachers should use more interesting and challenging software in school, and should make computers available to kids without home computers on an extracurricular basis.

Munger, Gail F., and Brenda H. Loyd. "Gender and Attitudes toward Computers and Calculators: Their Relationship to Math Performance." Journal of Educational Computing Research 5.2 (1989): 167-77.
Keywords: Attitudes and expectations, Mathematics
60 high school students were studied for the relationship between math performance and students' attitudes toward technology (computers and calculators). Greater computer confidence and more positive calculator attitudes correlated with higher math scores, but no gender-related differences were found.

Myers, Wendy, Sue Bennett, and Pauline Lysaght. "Asynchronous Communication: Strategies for Equitable E-Learning." Australian Society for Computers in Learning in Tertiary Education. Perth, 2004.
Keywords: Adults, Distance education, Telecommunications, Culture, Teachers and faculty, Outside U.S., Postsecondary/tertiary

Adult rural women university students in Australia were studied about their experience in online learning. 78% of the students getting their B.A. online were women. 16 women were studied (no information about selection procedures) via focus groups, interviews, and an email questionnaire. The women reported different male/female styles of online communication, particularly patronizing tones from some men and longer and more postings by men. They reported that men were responsible for spamming, personal attacks and sexism. The lecturer was asked to intervene but declined because "he didn't see that it was his place." Electronic teaching loses none of the gender dynamics of conventional learning environments.

Nachmias, Rafi, David Mioduser, and Anat Shemla. "Information and Communication Technologies Usage by Students in an Israeli High School: Equity, Gender, and inside/Outside School Learning Issues." Education and Information Technologies 6.1 (2001): 43-53.

Keywords: Use patterns, Outside U.S.

Urban high school students in Israel, grade 7-12, were surveyed. Boys reported greater usage than girls. (Reviewed abstract only)

Nass, Clifford, and Scott Brave. "Gender Stereotyping of Voices: Sex Is Everywhere." Wired for Speech: How Voice Activates and Advances the Human-Computer Relationship. Ed. Clifford Nass. Cambridge: MIT Press, 2005. Chapter 3.

Keywords: Stereotypes and bias, Software, Postsecondary/tertiary

This chapter describes the experiment conducted in Nass et al. (1997). In a second experiment, 80 students were directed to an online auction site that presented products for male and female categories (enclopedias of sewing and guns, books about Susan B. Anthony and men's watches and about the New York Giants and men's cowboy boots). Products were selected randomly and described randomly by synthesized male or female computer voices, clearly not human. Participants knew which products were "female" or "male." Product descriptions were seen as more credible when the gender of the voice matched the gender of the product, and the same-sex voice was seen as more appropriate for describing products than opposite-sex voices. Gender of the voices intensified the gender association of the product: female voices made products seem more feminine and male voices made products seem more masculine, so voice gender and product gender exerted a mutual influence on each other. "[N]ot only did the participants insist ... that it would be ludicrous to apply gender stereotypes to computer or synthetic voices; they also insisted that they were not guided by gender stereotypes in real life, either." To counteract gender bias, it would be easy to use female voices in software in stereotypically male subjects, or to have many voices with the majority female.

Nass, Clifford, Youngme Moon, and Nancy Green. "Are Computers Gender-Neutral? Gender Stereotypic Responses to Computers." Journal of Applied Social Psychology 27.10 (1997): 864-76.

Keywords: Stereotypes and bias

In an experiment with 40 university students, subjects were randomly assigned to 8 groups (male/female subject (computers & flowers), male/female computer voice in tutor role, male/female computer voice in evaluator role). Computers had voice output and voices were clearly synthetic, varying only in pitch. All three hypothesized stereotypes were confirmed. 1) Evaluation from males is more valid than evaluation from females. 2) Dominance in females is unbecoming. 3) Women know more about "feminine" topics, whereas men know more about "masculine" topics. "All subjects denied harboring stereotypes or being influenced by the gender of the computer voices. When asked, none of them said they thought the voices represented the programmers of the computers; in fact, most subjects thought the three computers in the experiment were programmed by the same person (which they were) and that the person was male (which is ironic, since they said they did not harbor stereotypes)." Conclusion: vocal cues embedded in a computer are sufficient to evoke gender stereotypes.

Nathan, Ronen, and Lois J. Baron. "The Effects of Gender, Program Type, and Content on Elementary Children's Software Preferences." Journal of Research on Computing in Education 27.3 (1995): 348-60.

Keywords: Software, Elementary/primary

62 4th grade children were given four software programs to use: two drill-and-practice (Word Attack Plus and Math Blaster Plus) and two tutorials (Grammar Gremlins and Mr. Math). There were no gender differences in choice of subject. Both girls and boys preferred Math Blaster to the others, so content trumped quality of program here.

National Alliance for Women in Communications Industries. "Lifting the Barriers to Computer Learning in Our Schools." Fast Forward 2.1 (1986).

Keywords: Barriers, Software, Attitudes and expectations, Mathematics, Programming

Programming is an advanced course for brightest math students, usually male; software is geared to males and is violent; boys are more aggressive in demanding computer time; computer expertise provides more status for boys than girls; and girls are conditioned to perceive programming as too difficult and a field more easily mastered by boys.

National Coalition of Girls' Schools. Girls & Technology: An Idea Book for Educators & Parents. Concord, MA: Author, 1998.

Keywords: Pedagogy, Interventions, Telecommunications, Career factors

Primarily teaching strategies.

National Science Foundation. Women, Minorities, and Persons with Disabilities in Science and Engineering, 2004. Arlington, VA: Division of Science Resources Statistics, NSF, 2004.

Keywords: Statistics

Compendium of statistics on science and engineering, from the undergraduate level to employment. Contains information on gender, race/ethnicity, and disability. Appears annually at http://www.nsf.gov/sbe/srs/wmpd/start.htm.

---. Women, Minorities, and Persons with Disabilities in Science and Engineering: 1994. Vol. NSF 94-333, 1994.

Keywords: Parents and home

10th grade males are much likelier than females to say they talk to parents about science and technology issues. (P. 22, Figure 2-10)

Nebraska Commission on the Status of Women. Nebraska Girls and Technology Status Report, 2003.

Keywords: Enrollments, Programming, Applications, Secondary/high school

In a statewide survey on high school computer course enrollment, boys outnumbered girls more than 2:1 in web design courses and more than 3:1 in more advanced technology courses, including programming and computer-aided design (CAD). They were only 6% of the students in the most advanced programming course. Enrollments were equal in applications courses.

Nelson, Carol S., and J. Allen Watson. "The Computer Gender Gap: Children's Attitudes, Performance and Socialization." Journal of Educational Technology Systems 19.4 (1991): 345-53.

Keywords: Early work, Parents and home, Software, Pedagogy, Teachers and faculty, Research review, Mathematics, Barriers

After reviewing the research, it is noted that early work focused on the link with math. Other barriers include family influences, gender bias in software, and teachers' resistance to using computers and resulting negative attitude. The article lists 18 factors that go into explaining gender differences in computing, in four categories: attitudes and performance factors, family factors, software factors, and educational factors.

Nelson, Lori, J., and Joel Cooper. "Sex Role Identity, Attributional Style, and Attitudes toward Computers." Eastern Psychological Association. Boston: ERIC 314 658, 1989.

Keywords: Attitudes and expectations, Elementary/primary

Fifth graders were surveyed about attitudes and attribution about gender differences in computer use after computer and video game experience. Boys and girls were enthusiastic about using computers and had positive attitudes, but girls used computers less than boys and felt they had less computer ability. (Reviewed abstract only.)

Nelson, Lori J., Gina M. Weise, and Joel Cooper. "Getting Started with Computers: Experience, Anxiety, and Relational Style." Computers in Human Behavior 7 (1991): 185-202.

Keywords: Experience, Programming, Games, Retention, Attitudes and expectations, Postsecondary/tertiary

College students were surveyed at the beginning and end of the semester in various computer-related courses. Males had significantly more prior experience with programming and games, and reported more knowledge about computers. By the end of the semester, females reported an equal amount of general computer knowledge as compared to males. Females who dropped out reported more anxiety than females who stayed, but the reverse was true for males (those with more anxiety stayed). Females who dropped out perceived the computer to be like a machine more than females who stayed; again, the reverse was true for males. There was a correlation between programming experience and retention, favoring males.

Neuman, Delia. "Technology and Equity." ERIC Digests (1991).
Keywords: Software
Brief summary on gender imbalances. Mentions limited hardware, stereotyped software.
Nicholson, Julie, Adrienne Gelpi, and Shannon Young. "Influences of Gender and Open-Ended Software on First Graders' Collaborative Composing Activities on Computers." Journal of Computing in Childhood Education 9.1 (1998): 3-42.
Keywords: Single-sex environment, Classroom interactions, Elementary/primary
First graders were observed composing stories on the computer. Girls working in mixed-sex groups were more likely to have their competence or work laughed at or criticized than in single-sex groups. Males more often interrupted females' concentration and composing efforts than the reverse. When girls worked in single-sex groups they found ways to incorporate all collaborators' ideas into stories, while boys tended to be competitive by comparing stories.
Nickell, G.S. et al. "Gender and Sex Role Preferences in Computer Attitudes and Experience." Southwestern Psychological Association. New Orleans, 1987.
Could not obtain: not reviewed.
Nolan, Patrick C.J., David H. McKinnon, and Janet Soler. "Computers in Education: Achieving Equitable Access and Use." Journal of Research on Computing in Education 24.3 (1992): 199-314.
Keywords: Access, Use patterns, Experience, Attitudes and expectations, Outside U.S.
In a survey of New Zealand secondary school students, it was found that boys used home computers more than girls but school computers equally. There was no gender difference in attitudes toward computers or in the use of games and most applications, as compared to a similar survey several years earlier. The research indicates "a further reduction of inequalities related to computer access at school to the point where there are no real differences across ability, gender, and socioeconomic divisions." (p. 310)
North, A.S., and J.M. Noyes. "Gender Influences on Children's Computer Attitudes and Cognitions." Computers in Human Behavior 18.2 (2002): 135-50.
Keywords: Attitudes and expectations, Experience, Outside U.S., Elementary/primary
The article considers "technophobia." Researchers gave a questionnaire and the Bem Sex-Role Inventory to about 100 11- and 12-year-old children in England. The extent of technophobia was found to be unrelated to either a student's sex or their sex-role profile (e.g. highly feminine girls). Less than a quarter of the children showed any level of technophobia. Males did have more computer experience than girls.
Oberman, Paul S. "Academic Help Seeking and Peer Interactions of High School Girls in Computer Science Classes." American Educational Research Association. New Orleans, 2000.
Keywords: Single-sex environment, Classroom interactions, Secondary/high school
Five girls at a Catholic high school and 20 girls at a public high school (in both schools a minority), were observed for help-seeking behavior in computer class. Both computer teachers were male, 31, and married. Girls often asked the person nearest them for help, and often asked peers even when they preferred help from the teacher and considered him more knowledgeable because they perceived him as somewhat unavailable. Most girls preferred to work individually, not with others in either single-sex or mixed-sex groups, even when there was substantial peer interaction.
Ogletree, Shirley M., and Sue W. Williams. "Sex and Sex-Typing Effects on Computer Attitudes and Aptitude." Sex Roles: A Journal of Research 23.11/12 (1990): 703-12.
Keywords: Experience, Attitudes and expectations, Postsecondary/tertiary,
College students were given questionnaires on sex typing, computer experience, computer attitudes, computer self-efficacy, and computer aptitude. High masculinity on the Bem Sex Role Inventory, rather than biological sex, was associated with more positive computer attitudes and higher expectations of succeeding in computer courses, as were computer ownership and use.
Okebukola, Peter A. "The Gender Factor in Computer Anxiety and Interest among Some Australian High School Students." Educational Research 35.2 (1993): 181-89.
Keywords: Attitudes and expectations, Outside U.S., Secondary/high school, Use patterns
Study of how gender affect computer anxiety and interest in computer use in Western Australian high school students. Students completed questionnaires. Girls had a significantly higher computer anxiety level, while boys had a significantly higher interest level.
Opie, Clive. "Whose Turn Next? Gender Issues in Information Technology." Gender in the Secondary Curriculum: Balancing the Books. Eds. Ann Clark and Elaine Millard. London: Routledge, 1998. 80-95.

Keywords: Attitudes and expectations, Access, Single-sex environment, Teachers and faculty, Race, ethnicity, or SES, Experience, Aggression, Research review, Outside U.S.

All students in Britain were required to take IT by the Educational Reform Act of 1988, and this chapter examines literature about computer equity before and after then to see if gender inequalities in IT have lessened. IT is not often enough integrated into the teaching of various subjects. Access remains mostly technologically based and male dominated. Computer faculty remain overwhelmingly male. Teachers believe that gender bias is a condition that is external to schooling. Single-sex groupings or classes are desirable to avoid boys' taking over the keyboard to "help" girls. Less privileged schools have less computer resources, and girls have less hands-on experience. Boys have and use home computers more than girls, and are more likely to have one in their own room, but when girls are given equal access they are equally enthusiastic. Computer confidence and competence rises with computer use, which is primarily gained at home, although there is some research about the importance of school computers.

Ory, John C., Cheryl Bullock, and Kristine Burnaska. "Gender Similarity in the Use of and Attitudes About Aln [Asynchronous Learning Networks] in a University Setting." Journal of Asynchronous Learning Networks 1.1 (1997): 39-51.

Keywords: Telecommunications, Distance education

Surveys, course monitoring, and interviews were carried out to determine how male and female college students responded to ALN (in this case, computer conferencing and the Web as an instructional medium) as an educational strategy. Males and females did not differ in terms of use (access frequency) or postings. Social and instructional types of online interactions equalized over the year (initially, social was equal whle instructional favored females). Ease of use was also equal, although initially more males found the system easy to use. There was no significant difference in assessment of the experience, with both sexes reporting it as positive. Females reported a greater increase in their computer familiarity than males over the year. Overall, there were few differences between males and females.

Osajima, April. "Email Message About New Video Game for Girls." 2004.

Keywords: Games

Girls Inc. developed a video game for girls called "Team Up" in which girls team up to solve playground puzzles. "There are no guns, nobody dies, and girls can chose the racial/ethnic make up of their team members. there are even different body sizes represented."

Palmer, Carolyn. "New Users in Jeopardy on Campus: What Can We Do?" Brown Online 2 (1989): 14-17.

Keywords: Experience, Race, ethnicity, or SES, Postsecondary/tertiary

A study of 2,270 undergraduates at the University of Illinois at Urbana-Champaign found that people of color had less computer experience than whites, and that in every racial/ethnic group females had less than males, with resulting educational inequities.

---. Women and Computers. March 6, 1989 1989.

Keywords: Experience, Use patterns, Postsecondary/tertiary, Physical safety

An analysis of computer use patterns at the University of Illinois at Urbana-Champaign revealed that men used computers available to students more in the Student Union and in the residence halls at all times. Physical safety after dark is an issue.

Parisi, Lynn. "Sex Equity in Computer Education: Concerns for Social Studies." ERIC Digest 15 (1984).

Keywords: Early work, Culture, Aggression, Mathematics

The computer gender gap is caused by the male culture of computers, the link with mathematics, and boys' aggressive behavior at the terminals.

Parker, Janet, and Constance Widmer. "Some Disturbing Data: Sex Differences in Computer Use." National Educational Computing Conference, 1984.

Keywords: Early work, Extracurricular programs, Programming

In this 1984 paper data was presented on a gender gap in high school and college programming courses and in high school computer clubs and computer contests.

Passig, David, and Haya Levin. "Gender Interest Differences with Multimedia Learning Interfaces." Computers in Human Behavior 15 (1999): 173-83.

Keywords: Telecommunications, Graphics, Preschool

Kindergarten students were studied about gender differences in multimedia design preferences. Males spent more time on task. Females were more likely to ask for help and preferred games that

involved writing. Males preferred green, blue, and movement, while females preferred red, yellow, and colorful screens filled with drawings.

Pearl, Amy, Martha E. Pollack, Eve Riskin, Beckly Thomas, Elizabeth Wolf, and Alice Wu. "Becoming a Computer Scientist: A Report by the Acm Committe on the Status of Women in Computer Science." Communications of the ACM 33.11 (1990): 47-57.

Keywords: Pipeline, Postsecondary/tertiary, Games, Software, Culture, Retention, Teachers and faculty, Physical safety, Attitudes and expectations, Role models and mentors, Stereotypes and bias, Career factors

Women are underrepresented in many sciences, but computing has some special factors. Recreational and educational software is based on an adolescent male culture, so by college computing has a male cultural component which leads to female dropouts and affects even women who persist. Faculty need an increased sensitivity to women students and colleagues. Women who use computers at school after dark face physical safety issues men don't, interfering with their education. Other factors common to women in male-dominated areas: low self-esteem, lack of role models and mentoring, gender discrimination, and career/family balance problems.

Pelgrum, W.J. "International Research on Computers in Education." Prospects 22.3 (1992): 341-49.

Could not obtain: not reviewed.

Perry, Ruth, and Lisa Greber. "Women and Computers: An Introduction." Signs: Journal of Women in Culture and Society 16.11 (1990): 74-101.

Keywords: Culture

To remedy "the increasing marginalization of women in computer science" (p. 90), girls must be reached. The male culture must be diminished and "a greater variety of intellectual styles" must be encouraged (p. 98)

Plamondon, Kathy Kidd. "Gender Differences among Early Elementary Students in Computer Use and Interest." Teaching and Change 1.3 (1994): 285-94.

Keywords: Elementary/primary, Preschool

K-2 students were offered the use of a computer as a composing medium. Girls chose the computer more often than boys did.

Pope-Davis, Donald B., and Jon S. Twing. "The Effects of Age, Gender, and Experience on Measures of Attitude Regarding Computers." Computers in Human Behavior 7 (1991): 333-39.

Keywords: Experience, Attitudes and expectations, Postsecondary/tertiary, Age

Contrary to other studies, it was experience (more) and age (older) and not gender that had a positive influence on computer attitudes among 207 American college students in education enrolled in an introductory computer course. There was no main effect for gender.

Pope-Davis, Donald B., and Walter P. Vispoel. "How Instruction Influences Attitudes of College Men and Women Towards Computers." Computers in Human Behavior 9 (1993): 83-93.

Keywords: Postsecondary/tertiary, Attitudes and expectations

American education and liberal arts college students were studied. About 60% chose to take a training course in microcomputers. The control group was an introductory psychology course for undergrads and graduate students; they received no special instruction in computers. Computer attitudes were measured. Males and females' attitudes (anxiety, confidence, interest and especially usefulness) improved after training compared to the pretest and the control group, despite a small pretest advantage in the experimental group for males in anxiety (less), confidence (more) and interest (more). Subjects were not randomly selected.

Pozzi, Stefano et al. "Learning and Interaction in Groups with Computers: When Do Ability and Gender Matter?" Social Development 2.3 (1993): 222-51.

Could not obtain: not reviewed.

Project on Equal Education Rights. Beyond the Star Trek Syndrome to an Egalitarian Future: 'Where No One Has Gone before'. Washington DC: NOW Legal Defense and Education Fund, 1986.

Keywords: Early work, Access, Applications, Programming, Parents and home, Stereotypes and bias, Career factors

Discusses access, applications vs. programming, home computers, sex bias and cognitive styles, and computer careers.

---. Sex Bias at the Computer Terminal: How Schools Program Girls. Washington DC: NOW Legal Defense and Education Fund, 1985.

Keywords: Early work, Programming, Software

The report discussed imbalances in programming, the importance of computer literacy, and biased computer-assisted learning software.

Proost, Karin, Jan Elen, and Lowyck Joost. "Effects of Gender on Perceptions of and Preferences for Telematic Learning Environments." Journal of Research on Computing in Education 29.4 (1997): 370-84.

Keywords: Distance education, Experience, Pedagogy, Cross-cultural, Outside U.S., Postsecondary/tertiary

A questionnaire was given to 1,368 university and distance education (= telematics) students in European countries. Women were found to have a significantly more negative perception of computers and a stronger preference for traditional educational environments than men, but this difference was more attributable to different experience levels with computers in general and distance education than gender. There was no gender difference in preference for audiovisual technology in education. Women were likelier to prefer social contact in their education more than men.

Pryor, J. "Gender Issues in Groupwork — a Case Study Involving Computers." British Educational Research Journal 21.3 (1995): 277-84.

Could not obtain: no review.

Pryor, John. "He, She, and I.T.: Groupwork in a Gender-Sensitive Area." British Educational Research Association. Liverpool, England, 1993.

Keywords: Interventions, Pedagogy, Single-sex environment, Elementary/primary, Outside U.S.

Nine- and 10-year old children in England were paired at computers. In the first year with a teacher who rarely practiced groupwork and was not particularly interested in gender equity, groupwork was often unsuccessful. Single-sex female pairs were not necessarily successful, and usually mixed-sex pairs were not helpful for the girls. Usually, assertive girls were able to work well with a female partner but assertive boys were not. Boys tended to be task-oriented while girls tended to be process-oriented. Little successful collaboration was observed. In the next year with a different teacher who was far more interested in gender equity, larger groups were created with student input, which in turn sometimes created subgroups. There was much more focused attention to collaboration and cooperation in groups. Boys learned greater sensitivity to the needs of their partners. Two deliberate interventions: female role models were brought in and gender-role discussions were held. This second class was much more successful. (Note however the uncontrolled number of variables involved.)

Reece, Carol Carter. "Gender and Microcomputers: Implications for the School Curriculum." Mid-South Educational Research Association. Memphis TN, 1986.

Keywords: Age, Parents and home, Attitudes and expectations, Elementary/primary, Middle school, Secondary/high school

In a study of elementary and secondary students, there was no relationship between sex and home computer ownership. There was no sex difference between computer attitudes among 5th or 7th graders, but there was among high school students.

Reinen, Ingeborg Janssen, and Tjeerd Plomp. "Gender Differences in Computer Use with Emphasis on Mathematic Education." International Journal of Educational Research?? (1993): ?

Could not obtain: not reviewed.

---. "Information Technology and Gender Equality: A Contradiction in Terminis?" Computers and Education 28.2 (1997): 65-78.

Keywords: Attitudes and expectations, Parents and home, Access, Role models and mentors, Teachers and faculty, Use patterns, Policy, Cross-cultural, Outside U.S., Elementary/primary, Middle school, Secondary/high school, Interventions

International data on computers in education, elementary through high school, in 20 countries in 1989 and 10 countries in 1992. In both studies, teachers and administrators were surveyed; students were also in the later one. In most countries, males scored higher on computer knowledge. In most countries, males and females were equally likely to see the computer as relevent, but in all countries females enjoyed using computers much less than males even though they believed both sexes enjoyed them equally (we can but I can't). In all countries in secondary education, more female than male students report that they have difficulties in understanding and using programs. "Overall, the most 'gender equal' picture on computer use by students is found in Bulgaria and the U.S.A., while Austria, Germany, and Latvia seem to be the countries with the largest gender

*differences in knowledge about, attitudes toward, and problems with computers." (p. 69) In terms of **parental** support, students in some countries report more parental encouragement for males; females reported more in Japan. Males have more **access** to computers at home in nearly all countries. In many countries females had access only to school computers, so equity policies in schools are especially important for females. In many countries, females are more likely to see a computer as relevant if they use school computers. "[S]ocialization experiences and access to computers lead, at least in some countries, to the creation and/or preservation of gender differences." (p. 73). Computer equity is highest in the U.S. In most countries, most computer teachers were male, except for the U.S., Bulgaria, and Latvia; perhaps the **role model** influence accounted for relative gender equity in the US and Bulgaria. On average, males used school computers for a larger number of activities than females and for more time, an alarming finding in view of the importance of school computers for girls. Very few schools had computer equity **policies**. Conclusion: gender equity concerns are well founded.*

---. "Some Gender Issues in Educational Computer Use: Results of an International Comparative Survey." Computers and Education 20.4 (1993): 353-65.

Keywords*: Interventions, Cross-cultural, Attitudes and expectations, Experience, Stereotypes and bias, Teachers and faculty, Access, Attitudes and expectations, Role models and mentors, Mathematics, Outside U.S.*

With data collected from teachers in 20 countries in a study by the International Association for the Evaluation of Educational Achievement, computer use in schools, elementary to high school, in most countries is dominated by men, with female teachers having less confidence in their skills and knowledge than male teachers. Except for French-speaking countries, few schools had a policy regarding computer equity. When it existed, such a policy usually involved having a woman become the computer teacher or coordinator, which was thought to produce more female role models. The article mentions four causes of a computer gender gap: motivational factors, knowledge and skill differences, socialization experiences, and differences in access. There were few female computer coordinators and principals to serve as role models. Women were underrepresented as computer-using teachers in most countries. Computer use is thus dominated by men, which conveys the suggestion to students that computing is an activity for men. Male teachers' self-ratings of computer knowledge, programming skill, and capability are higher than female teachers', which offers students a less positive role model. There was little male/female difference on attitude scales. Computer education tended to be associated with math and science, also male-dominated.

Rhem, James. "Pygmalion in the Classroom." National Teaching and Learning Forum 8.2 (1999).

Keywords: Teachers and faculty, Classroom interactions

Teachers' academic expectations for their students become self-fulfilling prophecies, experimentally established in primary grades, university, and the workplace. Robert Rosenthal, author of the original book published in 1968 and now teaching at Harvard, is interviewed for current information.

Rice, Marion. "Issues Surrounding the Integration of Technology into the K-12 Classroom: Notes from the Field." Interpersonal computing and Technology 3.1 (1995): 67-81.

Keywords: Experience, Use patterns, Aggression

In focus groups and interviews with teachers, it was found that though boys are initially more interested in using computers, girls' interest increases with exposure. Girls often used computers for different purposes than boys, more word processing than boys. Boys are more aggressive about getting computer time and are likelier to use computers for play while girls are more practical.

Richards, P. Scott, David W. Johnson, and Roger T. Johnson. "A Scale for Assessing Student Attitudes toward Computers: Preliminary Findings." Computers in the Schools 3.2 (1986): 31-38.

Keywords: Attitudes and expectations, Methodology, Middle school, Secondary/high school,

Article about the development of a Computer Attitude Scale with a group of junior high and senior high students in an "upper class suburb of Minneapolis." The scale found that with junior high students, males scored higher on the Male Domain scale and the Necessity for Computers scale; there was no sex difference in the Liking of Computers scale. At the high school level, males continued to score higher on the Male Domain score but there was now no difference on the Liking of Computers and Necessity of Computers scales.

Rifkin, Adam. "Caltech Crpc Outreach Programs for Minorities and Women." National Educational Computing Conference. Baltimore, 1995.

Keywords: Interventions, Race, ethnicity, or SES

The Center for Research on Parallel Computation at Caltech held four outreach programs for minority males and females: a two-day on-campus event for high school students, a five-day workshop for minority high school teachers, a workshop at a computing conference, and summer research projects for female college juniors and seniors. No information about outcomes is presented.

Ring, Geoff. "Student Reactions to Courseware: Gender Differences." British Journal of Educational Technology 22.3 (1991): 210-15.

Keywords: Software, Attitudes and expectations, Outside U.S.

Australian students ages 5 to 13 rated courseware packages. Male students had greater confidence in their ability to use the courseware as an effective learning tool than female students.

Roberts, Eric S., Marina Kassianidou, and Lilly Irani. "Encouraging Women in Computer Science." SIGCSE Bulletin 34.2 (2002): 84-88.

Keywords: Interventions, Barriers, Software, Culture, Experience, Role models and mentors, Postsecondary/tertiary

Barriers to women the same as engineering, plus a few specific to CS: prior computer experience is lower for women, software incorporates gender biases, male culture. Strategies adopted at Stanford to encourage women in CS: creation of a "wide-audience" intro course that offers role models for women, providing role models at different levels, three bridge programs to CS and engineering (including a 2.5-week summer course for sophomores, "The Intellectual Excitement of Computer Science," with 50% female enrollment), research opportunities for students and faculty mentors, the encouragement of student research on gender in computing, and others in the making.

Robinson-Staveley, Kris, and Joel Cooper. "Mere Presence, Gender, and Reactions to Computers: Studying Human-Computer Interaction in the Social Context." Journal of Experimental Social Psychology 26 (1990): 168-83.

Keywords: Context, Experience, Attitudes and expectations, Postsecondary/tertiary

The effects of mere presence, expectations for success, gender, and level of computer experience on reactions to computers were examined.

In Study 1, 80 male and female college students completed a difficult computer task and a series of questionnaires in the presence or absence of another person. For women with little previous computer experience, those who worked in the presence of a same-sex confederate performed much less well, expressed more negative attitudes toward computers, and reported higher anxiety than did women who worked alone. For men, mere presence had the opposite effect. Performance and reactions of subjects high in computer experience were unaffected by gender or mere presence.

In Study 2, 80 low-experience experience students were included. Expectations for success were manipulated and interacted with the presence of a same-sex confederate, resulting in facilitation for positive expectancy subjects and impairment for negative expectancy subjects, relative to those working alone. Men and women were equally affected by the presence of another person. Gender differences in expectations for success seem to have determined whether mere presence resulted in facilitation or impairment effects. "It is clear that [women's] inherent expectations [of success] can not always be easily changed, but it is also clear than when they are changed, the result is improvement in performance, anxiety, and attitude." (p. 181)

Robst, John, Dean Russo, and Jack Keil. "Female Role Models: The Effect of Gender Composition of Faculty on Student Retention." Association for Institutional Research. Albuquerque, 1996.

Keywords: Role models and mentors, Teachers and faculty, Mathematics, Retention, Postsecondary/tertiary

This study examined whether female college freshmen over four years at SUNY-Binghamton in science, math and computer classes had higher first-year retention rates (= return for the sophomore year) when a greater percentage of their classes were taught by female faculty (not teaching or lab assistants). A significant positive relationship was found between retention and the percentage of science, math and computer science courses taken by female students that were taught by women, although not for women taking other courses and not for men. "Retention rates [for women in

math, science and technology] increase as the percentage of credits taken from female faculty increase." (p. 10)

Rosenthal, Nina Ribak, and Diana Mayer Demetrulias. "Assessing Gender Bias in Computer Software." Computers in the Schools 5.1/2 (1988): 153-63.

Keywords: Software, Stereotypes and bias

Researchers evaluated software for children and saw no examples of blatant sexism but many examples of subtle sexism (e.g. animals dressed in sex-typed clothes doing sex-stereotyped things). Teacher education students, nearly all female, evaluated software using three different evaluation forms, one of which asked detailed questions about gender issues in software and the other two asked one general question (e.g. "Is the content free of race, ethnic, sex, and other stereotypes?" No programs were identified as sexist using the general-question evaluation form but three were using the gender-specific evaluation form.

Rothstein, Edward. "Girl Software: A Fantasy World Stressing Advice and the Anxiety of Romance." New York Times February 17 1997.

Keywords: Software, Games, Stereotypes and bias

Discusses software for girls: themes of appearance, romance, personality, charm, and friends. "These games take little notice of any of the arguments of recent decades — that the differences between girls and boys are socially conditioned and environmentally created. Girl software insists on those differences, and the market provides support."

Roy, Marguerite, Roger Taylor, and Michelene T.H. Chi. "Searching for Information on-Line and Off-Line: Gender Differences among Middle School Students." Journal of Educational Computing Research 29.2 (2003): 229-52.

Keywords: Telecommunications, Middle school

28 8th grade students were randomly assigned to a Web or library search condition to answer a question about mosquitoes. Boys learned more information than girls in the Web condition. (Reviewed abstract only)

Rubin, Andee, Megan Murray, Kim O'Neil, and Juania Ashley. "What Kind of Educational Computer Games Would Girls Like?" American Educational Research Association. Chicago, 1997.

Keywords: Software, Games, Stereotypes and bias, Elementary/primary

The authors are concerned with educational computer games on math that interest girls. Much "girl" software "appeals to stereotypically female interests: shopping, makeup, fashion, dating." (p. 1) Using the Logical Journal of the Zoombonis (developed at TERC, published by Broderbund), they noted that 3rd to 5th grade girls were as enthusiastic about it as boys because of greater character dimensionality, the puzzle nature of the game, and opportunities for communication the game affords.

Ryan, C. "Raising Girls' Awareness of Computer Careers." 5th IFIP International Conference on Women, Work and Computerization. Manchester, UK, 1994.

Could not obtain: not reviewed.

Sackrowitz, Marian. An Unlevel Playing Field: Women in the Introductory Computer Science Courses. Princeton NJ: Princeton University, 1995.

Keywords: Experience, Attitudes and expectations, Pipeline, Postsecondary/tertiary

Rutgers and Princeton students in the introductory computer science course were studied, of whom about 30% were women. The groups were different in many ways (at Rutgers nearly half intended to major in CS while at Princeton only 16% did; Rutgers students were on the average older). While there were a variety of different results in the two campuses, the overall conclusion is that men's earlier computer success leads to future success, while women's lesser early experience leads to greater difficulty later. "There seems to be a positive feedback loop operating for the men and a negative one operating for the women." (p. 14)

Sacks, Colin H., Yolanda Bellisimo, and John Mergendoller. "Attitudes toward Computers and Computer Use: The Issue of Gender." Journal of Research on Computing in Education 26.2 (1993): 257-69.

Keywords: Attitudes and expectations, Secondary/high school, Experience, Applications

Students with deficient academic skills and little prior computer experience in an alternative high school were studied about their attitude toward and use of computers for word processing. Girls and boys had about the same liking and confidence scores in the pretest. Girls' attitudes improved

over the four months while those of boys did not. There were no sex differences in computer use. Boys' attitudes did not correlate with their computer use, but girls' attitudes did.

Sanders, Jo. "Closing the Gender Gap." The Executive Educator (1993): 32-33.

Keywords: Interventions, Attitudes and expectations

The causes of the computer gender gap are subtle and usually inadvertent. Teachers resist computer equity training because they think they will be yelled at. It is important for everyone to understand the inadvertence of the problem for it to be resolved.

---. "The Computer Gender Gap: Close It While There's Time." The Monitor 24.7/8 (1986): 18 ff.

Keywords: Use patterns, Interventions

Reports on the Computer Equity Expert Project, where girls' computer use increased 144%. Interventions are suggested.

---. Gender and Technology: A Research Review. Seattle: Center for Gender Equity, 2005.

Keywords: Research review

This is a comprehensive review of research on gender and technology in education around the world in these areas: societal influences; age, stage and pipeline issues; experience, attitude, and use patterns; in the classroom; special efforts; and conclusions about what we need to know and what we need to do. The bibliography you are consulting now was developed for this research review. A shorter version will be published by Sage in London in the Handbook of Gender in Education in 2006, edited by Chris Skelton, Becky Francis, and Lisa Smulyan.

---. "Girls and Technology: Villain Wanted." Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics and Engineering. Ed. Sue V. Rosser. New York: Teachers College Press, 1995. 147-59.

Keywords: Culture, Parents and home, Curriculum, Classroom interactions, Interventions, Peers and friends

The author discusses the male computer culture, parental factors, curriculum factors, biased teacher behaviors, and peers' attitudes. Possible interventions are presented.

---. "How Do We Get Educators to Teach Gender Equity?" Is There a Pedagogy for Girls? Conference report, London, England, 1995.

Keywords: Teachers and faculty, Teacher education

In the last 20 years gender equity specialists in computing and other areas have produced vast quanties of print and audiovisual materials and given thousands of workshops for classroom teachers, but "the education establishment has not been lining up to buy what we are selling." (p. 2) The author describes what she has found effective in terms of seminar content, seminar atmosphere, followup, and the need to provide teachers with stipends and attractive seminar locations.

---. Lifting the Barriers: 600 Strategies That Really Work to Increase Girls' Participation in Science, Mathematics, and Computers. Seattle: Jo Sanders Publications, 1994.

Keywords: Interventions, Curriculum, Extracurricular programs, Role models and mentors, Parents and home, Teacher education

Interventions in these areas: contests and competitions, counselors, curriculum, extra-curricular clubs and programs, field trips, fundraising, materials, mentoring, parents, policies, recruiting girls for advanced courses, role models/visitors/speakers, scheduling and resource allocation, spreading the equity word to students and colleagues, and teaching techniques. Now out of print, it is available on line at www.josanders.com.

---. "The Molehill and the Mountain." TIES: The Magazine of Design and Technology Education (1998): 1.

Keywords: Media

Analyzes several previous issues of this magazine for how it portrayed men and women, and found that men were about 75% of those pictured and mentioned.

---. "Snatching Defeat from the Jaws of Victory: When Good Projects Go Bad. Girls and Computer Science." American Educational Research Association. New Orleans, 2002.

Keywords: Interventions, Enrollments, Teachers and faculty, Advanced Placement, Secondary/high school

The paper reports on the 6APT project held 1996-99 at Carnegie Mellon University and why it wasn't more successful. There was an increase in the number of teachers carrying out equity strategies after the seminars, but the increase in female (and male) enrollment in Advanced Placement (AP) computer science was more likely due to the change from Pascal to C++ as the AP exam

language. The number and type of strategies did not appear to be related to changes in enrollment, since teachers with increased female enrollment carried out fewer intervention strategies than those without increased female enrollment. Possible explanations for the failure: often lone teachers from a school participated in the project, there was insufficient followup after the seminars, the strategies may not have been carried out well or may not have been the most effective ones.

Sanders, Jo. "Teacher Education and Gender Equity." ERIC Digest 96.3 (1997).

Keywords: Teacher education

Summary of gender equity issues and the lack of attention to these issues in pre-service teacher education.

---. "Teaching Teachers About Gender Equity in Computing." Crossing Cultures, Changing Lives: Integrating Research on Girls' Choices of IT Careers. Oxford, England, 2005.

Keywords: Teacher education, Teachers and faculty, Barriers

Describes what the author has learned in three decades of teaching teachers about gender equity in computing: sources of their resistance, the aspects of gender equity work with teachers we don't yet understand and need to do more research on, and what seems to work: no blame, use local data, classroom observation exercises, present research, pay attention to the WIIFM rule (What's In It For Me), be explicit when modeling good teaching behavior (must name it!), and praise whenever possible. One of the barriers to progress is the fragmented organization of education in the U.S. in K-12 and in postsecondary teacher education.

---. "What Works to Create Change on an Individual Basis?" American Educational Research Association. New York City, 1996.

Keywords: Teacher education, Teachers and faculty, Critical mass, Males, Postsecondary/tertiary

As ways to help teachers make progress on computer equity and other equity areas, several approaches are discussed: no blame, women as well as men need gender equity help, an emphasis on facts and not values, sharing one's own sexism, being as professional and classy as possible, and providing many supporting materials. It turns out that working with teachers who work together is not better than working with teachers who participate in a project alone (a critical mass point), and at the postsecondary level academic rank makes no difference either. Men were more likely to make equity progress than women even though they all started out at the same point.

---. "Women in Science and Technology, and the Role of Public Policy." Association for Public Policy Analysis and Management. Seattle, 2000.

Keywords: Teacher education,

The essence of various projects is that educators, particularly policy makers, must decide if they believe gender equity in computing and other areas has a legitimate place in the pre-service teacher education curriculum. If so, then it follows that gender equity must be systemic, that education professors be helped in being brought up to speed, and that gender equity in computing must be on the agenda of the teacher education profession.

---. "Computer Equity for Girls." Sex Equity in Education: Readings and Strategies. Ed. Anne O'Brien Carelli. Springfield, IL: Charles C. Thomas, 1988. 157-72.

Keywords: Curriculum, Interventions, Classroom interactions, Teachers and faculty, Peers and friends, Policy

After summarizing evidence for and consequences of the computer gender gap, the authors present intervention categories for teachers: focus specifically on girls, stress usefulness, schedule optional computer time, start a girls' computer committee, offer computer graphics, have girls help teach computing, hold a computer career fair. Interventions for administrators are: educate faculty, expand faculty access to computers, establish computer equity as policy. The authors warn that the computer gender gap will not disappear soon, and that educators must decide whether computer use should be entirely optional or totally required for all — the authors recommend that it be required.

---. "Computer Equity for Girls: What Keeps It from Happening?" Computers in Education. Sydney, Australia, 1990. 181-87.

Keywords: Attitudes and expectations, Use patterns

The author discusses equality of opportunity vs. equality of outcome, and argues that special efforts to equalize computer outcomes are necessary. Current inequality is due to the legacies of history,

sex-biased attitudes, the ways schools operate, and issues of value, choice and responsibility, all of which change and are changeable.

Sanders, Jo. Counting on Computer Equity: A Quick and Easy Guide for Finding out If Your School Has a Computer Gender Gap. Metuchen, NJ: Scarecrow Press, 1991.

Keywords: Elementary/primary, Middle school, Secondary/high school, Postsecondary/tertiary, Adults

Needs assessment guide for schools to determine if computer use and enrollment is equitable.

---. Does Your Daughter Say "No, Thanks" To the Computer?: Women's Action Alliance, 1989.

Keywords: Parents and home

Describes the computer gender gap at home and what parents can do about it.

---. "Equity and Technology in Education: An Applied Researcher Talks to the Theoreticians." Equity in Education. Ed. Walter G. Secada. Philadelphia: Falmer Press, 1989.

Keywords: Policy, Teacher education, Attitudes and expectations, Stereotypes and bias

The author discusses equality of opportunity vs. equality of outcome, and argues that special efforts to equalize computer outcomes are necessary. Current inequality is due to the legacies of history, sex-biased attitudes, the ways schools operate, and issues of value, choice and responsibility, all of which change and are changeable. Further research is called for in the areas of educators' attitudes about computers and sex stereotypes, parents, schools, and girls.

---. "What We Can Learn from Girls' Computer Avoidance." NCSEE News (National Coalition for Sex Equity in Education) (1993).

Keywords: Interventions, Teachers and faculty, Classroom interactions

Girls' computer avoidance is caused not by big dramatic events but by subtle, small, trivial events that may be inadvertent, unintentional and even unconscious. Teachers avoid gender equity training for fear they will be blamed. Interventions must take these realities into account.

Sanders, Jo, and Patricia B. Campbell. "Making It Happen: The Role of Teacher Education in Ensuring Gender Equity." AACTE Policy Perspectives 2.4 (2001): 1-5.

Keywords: Teacher education

Discusses the lack of systematic attention to gender issues in pre-service teacher education and including gender equity in the teacher education agenda.

Sanders, Jo, and Rebecca Lubetkin. "Preparing Female Students for Technician Careers: Dealing with Our Own Elitist Biases." Peabody Journal of Education 66.2 (1991): 113-26.

Keywords: Career factors, Postsecondary/tertiary

Technician-level careers for women are often invisible to educators whose idea of success is a college or graduate school degree. Future computer equity efforts must encourage women to consider technician-level careers.

Sanders, Jo, and Mary McGinnis. "Closing the Computer Gender Gap in School." Women's Worlds: The Third International Interdisciplinary Congress on Women. Dublin, 1987.

Keywords: Early work, Classroom interactions, Software, Aggression, Peers and friends, Mathematics, Teachers and faculty

Evidence, consequences, and causes of the computer gender gap are presented. Causes: Math, machines, software, stereotypes, first-come/first-served, competing interests, unorganized computer time, computers without instruction, home responsibilities. The experiment in Fish et al. (1986) is summarized. Major lessons: target girls clearly and in friendship groups, make computing useful, use software girls find attractive, and make the teacher pro-active.

Sanders, Jo, and Sarah Cotton Nelson. "Closing Gender Gaps in Science." Educational Leadership 62.3 (2004): 74-77.

Keywords: Interventions, Mathematics, Advanced Placement, Secondary/high school

Describes a teacher training project in Dallas that was funded by The Women of TI with computer science and science teachers of Advanced Placement (AP) courses in high school. The project originated when it was discovered that girls who scored high in the PSAT-Math exam under-enrolled in AP science and CS courses and scored lower than boys with similar PSAT-Math scores. The project was effective with physics teachers and less o with chemistry teachers. Because the programming language for the CS exam changed in the middle of the project, pre/post comparisons were impossible in CS.

Sanders, Jo, and Susan Tescione. Equity in Information Technology: Recruitment Materials. 2003. Internet. Available: http://www.josanders.com/recruitment.htm, retrieved July 14, 2005.

Keywords: Postsecondary/tertiary, Recruitment

These materials are intended primarily for postsecondary administrators and recruiters to help them increase the number of females and people of color for their IT and CS programs, but it can be used at the secondary level as well. It contains a handbook with recruitment guidelines, a poster (with reply card), and a brochure. The basis for the materials is that something different must be done in recruitment if IT/CS programs are to recruit different (meaning not white or Asian males) students.

Sanders, Jo, and Susan T. Tescione. Equity in the It Classroom. 2004. Web-based course. Available: http://www.josanders.com/portal/index.htm, retrieved July 14, 2005.

Keywords: Departmental change, Race, ethnicity, or SES, Retention, Enrollments, Teachers and faculty, Teacher education, Language and terminology

This is an interactive web-based course on gender and race/ethnicity in IT in education and occupations. Module 1 covers basic concepts and terminology. Module 2 is a presentation of the current situation for females and people of color in IT education and employment. Module 3 addresses barriers to recruitment and retention. Module 4 presents what IT instructors and departments can do to increase the number of females and people of color in IT. The course was developed for postsecondary IT instructors, but it is usable by others as well.

---. "Gender Equity and Technology." Defining and Redefining Gender Equity in Education. Ed. Janice Koch & Beverly Irby. Greenwich, CT: Information Age Publishing, 2002. 99-115.

Keywords: Research review

A review of the status of girls and women in technology education and occupations, factors in the low recruitment and retention of females, and successful strategies and programs.

Sanders, Jo Shuchat. "The Computer: Male, Female or Androgynous?" The Computing Teacher (1984): 31-34.

Keywords: Early work, Stereotypes and bias, Attitudes and expectations, Parents and home, Software, Classroom interactions

Article presented "speculations" about the causes of the computer gender gap in terms of 29 factors in attitudes and associations, developmental and behavioral factors, parents, software and computer use, and school logistics, and called for research in these areas.

---. "Here's How You Can Help Girls Take Greater Advantage of School Computers." American School Board Journal (1985): 37-38.

Keywords: Early work, Teachers and faculty, Interventions, Access, Software, Policy

Recommendations for actions school boards can take to remedy computer inequity: increase optional access, set policy on bias in software, provide training to teachers in computers and sex equity, require computer courses, assign women to computer staff, and counteract sex stereotyping.

---. "Making the Computer Neuter." The Computing Teacher (1985): 23-27.

Keywords: Media, Early work, Classroom interactions, Teachers and faculty, Peers and friends, Parents and home

The article analyzed the computer gender gap in terms of the male bias in computer media, in home computer ownership and use, and software. About half the computer teachers are female, so it can't be due to male teachers. One reason is the absence of girls' girlfriends, not the presence of boys. Social interactions at the computer help.

---. "Reflections from the Computer Equity Training Project." American Educational Research Association. Chicago, 1985.

Keywords: Early work, Programming, Teachers and faculty

Programming gender gap remained constant between 1978 and 1982. Paper presents evidence for the computer gender gap at school, home, in summer camps, in computer magazines, and in occupations. It identifies six of the 29 "speculations" (Sanders, 1984) which are "nearly certain" as causes of the computer gender gap and five that are "probable." It specifies teachers as key.

Sanders, Jo Shuchat, and Antonia Stone. The Neuter Computer: Computers for Girls and Boys. New York: Neal-Schuman Publishers, 1986.

Keywords: Barriers, Use patterns, Parents and home, Teacher education, Interventions, Access, Peers and friends, Interventions

Strategies for educators, parents, and students.

Sax, Linda J., Alexander W. Astin, William S. Korn, and Kathryn M. Mahoney. The American Freshman: National Norms for Fall 2000: UCLA, 2001.

Keywords: Use patterns, Attitudes and expectations

In the fall 2000 survey of over 400,000 entering freshmen across the U.S., computer use was essentially equal but the gender gap in computer skill confidence was wider than at any time in the 35-year history of the survey. Twice as many men (46%) as women (23%) felt their computer skills were above average.

Schaumburg, Heike. "Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help to Level out the Gender Difference?" National Educational Computing Conference. Chicago, 2001.

Keywords: Attitudes and expectations, Interventions, Secondary/high school, Access

A computer literacy test was given to 9th grade students. In two classes students were using laptop computers for the third year and could take them home. In three other classes from the same school, students did not have laptops; 54% of these had their own computers. Computers were also available in the school. Girls without laptops scored lower on almost all of the computer literacy subtests than boys without laptops (the control group). In the experimental group, however, girls scored equally with boys on about half the subtests. They still scored lower than the boys in general confidence in using the computer and knowledge of hardware, the operating system, and security issues. Experimental girls scored higher in computer knowledge measures than control group girls. However, the researcher did not mention the basis on which students were or were not assigned laptops, nor were pretests done with these students.

Schoenberg, Judy. The Girl Difference: Short-Circuiting the Myth of the Technophobic Girl. New York City: Girls Scouts of the United States of America, 2001.

Keywords: Access, Use patterns, Games, Parents and home, Culture, Role models and mentors, Curriculum

While girls now have the same access to technology as boys, three gender gaps remain: in degree of use, in courses in school, and in employment. Girls now use computers differently but as often as boys, games are still male-oriented, children use home computers more than school computers (therefore SES is important, not race/ethnicity), and girls are still not equal in technology careers. Adults are not encouraging girls to take technology, girls perceive themselves as outside the technology culture, games are still male, the computer scientist is associated with maleness, CS is taught in isolation of other subjects, lack of mentors.

Schofield, Janet Ward. Computers and Classroom Culture. New York: Cambridge University Press, 1995.

Keywords: Role models and mentors, Curriculum, Culture, Classroom interactions, Mathematics, Experience, Secondary/high school, Programming

In her chapter "Girls and computer science: Fitting in, fighting back, and fleeing" (pp. 164-189) she explores why high school girls she observed tended not to enroll in advanced computer classes and what the environment was like for those who did. She cites a lack of female role models, location of the courses in the math department, an exclusive curricular focus on programming, stereotyped course materials, male-oriented teaching examples, and lower prior computer experience for girls. In an advanced computer class, girls were excluded and subject to isolation, teasing, taunting, and even outright sexual harassment, which negatively affected their comfort and sense of belonging.

Schott, Gareth, and Neil Selwyn. "Examining The "Male, Antisocial" Stereotype of High Computer Users." Journal of Educational Computing Research 23.3 (2000): 291-303.

Keywords: Stereotypes and bias, Use patterns, Secondary/high school, Outside U.S.

The authors studied 117 12th graders in two comprehensive schools in the UK, half male and half female. They took a survey on home and school computer use, attitudes toward ICT, and social competence (= social acceptance, close friendship, and self-worth). Students were evenly divided by sex in terms of computer use level. High computer use for both boys and girls correlated with high social competence, but low computer users of both sexes also scored high in social competence. In focus groups, low ICT level students stereotyped high-level users negatively, which may have caused them to avoid the computer. The image of the antisocial male nerd as a discouraging factor for girls therefore is not borne out, and contrary to much other research neither was there a difference in computer use level. However, the stereotype remains and may cause computer avoidance among girls and boys.

Schubert, Jane G. "Gender Equity in Computer Learning." Theory into Practice 25 (1986): 267-75.

Could not obtain: not reviewed.

Schumacher, P., and J. Morahan-Martin. "Gender, Internet, and Computer Attitudes and Experiences." Computers in Human Behavior 17.1 (2001): 95-110.

Keywords: Use patterns, Programming, Games, Parents and home, Attitudes and expectations, Experience, Postsecondary/tertiary

Incoming college students were studied in 1989, 1990 and 1997 for computer skills and attitudes, and the 1997 cohort also for Internet and e-mail skills and attitudes. In 1989 and 1990 and again in 1997, there was no significant gender difference in the percentage of males and females reporting school or home use of a computer or having taken a course that required computer use, although use levels increased dramatically over the two time periods. Earlier, males used the computer more than females for writing, graphics, games, and programming; later, games and programming remained mostly male. Males continued to spend considerably more time at the computer in 1997. In 1997 males reported more home computer ownership, experience, skill, and time spent with the Internet than females. Males reported higher comfort and confidence with the computer and with the Internet, and these attitudes correlated with skills and experience. Game-playing, which remains male-oriented, may enhance programming skills.

Scragg, Greg, and Jesse Smith. "A Study of Barriers to Women in Undergraduate Computer Science." SIGSCE '98. Atlanta, 1998.

Could not obtain: not reviewed.

Selby, Linda. "Increasing the Participation of Women in Tertiary Level Computing Courses: What Works and Why." Australian Society for Computers in Learning in Tertiary Education. Perth, 1997.

Keywords: Career factors, Culture, Attitudes and expectations, Role models and mentors, Classroom interactions, Programming, Mathematics, Pedagogy, Secondary/high school, Postsecondary/tertiary, Outside U.S.

Commissioned by the New Zealand Ministry of Education to study the conditions that affect women in postsecondary CS and IT courses, the author surveyed and interviewed women, staff, and high school girls. Factors that influenced females' low CS and IT enrollment were found to be: 1) high school girls' lack of knowledge about computer careers, 2) a negative image of computer professionals as nerdy and geeky and of computing as a machine-oriented, solitary, and mathematical occupation, 3) a lack of confidence despite abilities and successes, 4) lack of women lecturers means few role models, 5) computing is perceived as a male domain, and 6) a poor teaching and learning environment: male staff appeared to be more comfortable with male students and programming was taught poorly and without relevance to workplace environments. The paper includes recommendations for improvement in each of these areas.

Selwyn, Neil. "Students' Attitudes Towards Computers in Sixteen to Nineteen Education." Education and Information Technologies 4.2 (1999): 129-41.

Keywords: Attitudes and expectations, Outside U.S.

In a study of students in Wales ages 16 to 19, it was found that gender exerted only a minor influence on their computer attitudes. (Reviewed abstract only)

Sensales, Gilda, and Patricia M. Greenfield. "Attitudes toward Computers, Science and Technology: A Cross-Cultural Comparison between Students in Rome and Los Angeles." Journal of Cross-Cultural Psychology 26.3 (1995): 229-42.

Keywords: Cross-cultural, Attitudes and expectations, Outside U.S.

In a survey of university students in the US (Los Angeles) and Italy (Rome), nationality/culture and field of study were larger factors in computer attitudes than gender.

Seymour, Elaine, and Nancy M. Hewitt. "Issues of Gender." Talking About Leaving: Why Undergraduates Leave the Sciences. Boulder, CO: Westview Press, 1997. 231-318.

Keywords: Retention, Culture, Research review, Career factors, Role models and mentors, Teachers and faculty, Postsecondary/tertiary, Secondary/high school, Adults, Stereotypes and bias

Although not specifically on computer science, the chapter on women (Chapter 5, pp. 231-318) is one of the best resources for understanding women's low representation in male-dominated disciplines. See also the excellent Chapter 6, "Issues of Race and Ethnicity," pp. 319-390.

Shade, Daniel. "Computers and Young Children: Software Types, Social Contexts, Gender, Age, and Emotional Responses." Journal of Computing in Childhood Education 5.2 (1994): 177-209.

Keywords: Attitudes and expectations, Age, Peers and friends, Software, Preschool, Elementary/primary, Context

Middle-class children aged 4-8 were studied at a computer with variations with software that varied developmental levels of appropriateness (randomly assigned) and with or without a peer. Peers were also randomly assigned but only in the same gender. Kids were videotaped for facial expressions. The younger children (4-5) were more discriminating about software than older ones. Girls responded more to developmentally appropriate software, whereas boys responded more to low-level more competitive drill software. Older children in the peer condition exhibited more enjoyment when together than when alone.

Shapka, Jennifer D., and Michel Ferrari. "Computer-Related Attitudes and Actions of Teacher Candidates." Computers in Human Behavior 19.3 (2003): 319-34.

Keywords: Attitudes and expectations, Teacher education, Outside U.S.

56 pre-service teachers in Ontario, Canada in elementary/middle and secondary education were studied with respect to their computer attitudes. They were given an unfamiliar word processing task to do and attitude questionnaires. Except for a greater female likelihood to ask for help, no gender differences were found. "[G]ender effects among well-educated college-age students may be becoming a rarity." (p. 330) The authors did note that the lack of gender differences may have been due to the familiarity of word processing.

Shashaani, Lily. "Gender Differences in Computer Attitudes and Use among College Students." Journal of Educational Computing Research 16.1 (1997): 37-51.

Keywords: Attitudes and expectations, Experience, Parents and home, Stereotypes and bias, Postsecondary/tertiary

The computer attitudes and experience of 202 college students enrolled in a required introductory CS course were surveyed at the beginning and end of the semester. Women scored lower than men in liking to learn about computers, enjoying working with computers, considering computers exciting, and confidence in dealing with computers. There was no difference in the perceived usefulness of computers. Men had more experience with computers than women. Most home computers owners were male. Both sexes agreed that parents, especially fathers, believed that computers are more appropriate for males than females. Prior computer experience correlated with positive attitudes. Female students who perceived their parents believing that computers were more appropriate for males were less interested in computers and had lower confidence in their computer ability than other female students. By the end of the semester, both male and female students had more positive computer attitudes. Despite females' lower computer confidence, they performed much better and got higher grades than males.

---. "Gender Differences in Computer Experiences and Its Influence on Computer Attitudes." Journal of Educational Computing Research 11.4 (1994): 347-67.

Keywords: Experience, Attitudes and expectations, Parents and home, Stereotypes and bias, Secondary/high school

1,730 9th and 12th grade students were studied in 1991-92 about their computer experience in school and at home and their computer attitudes. ***School computer use****: boys were more likely to take computer-related courses and to take more of them. They spent more time on school computers than girls. Boys were likelier to plan on taking more computer classes, especially at the 12th grade level.* ***Home computer use****: more boys reported a computer at home. Twice as many boys as girls said they were the primary users. Boys were likelier to have used a computer first at home, while for girls it was at school.* ***Attitudes****: boys were more interested and had more self-confidence. Girls strongly believed in gender equality in computer skill and ability, unlike boys.* ***Experience x attitudes****: There was a weakly positive correlation between computer class enrollment and computer attitudes for both sexes. The presence of a home computer did not associate with students' computer interest at all. For boys, level of computer usage and number of computer courses taken correlated with self-confidence; no such relationship was found for girls. Students who used computers more, both boys and girls, were more in favor of sex equality in computer ability. The number of computer courses taken correlated strongly with perceived utility for both sexes.* ***Conclusion****: the author found significant differences favoring boys in computer experience in school and at home, computer class participation, amount of computer usage, and computer ownership.*

Shashaani, Lily. "Gender Differences in Mathematics Experience and Attitude and Their Relation to Computer Attitude." Educational Technology 35.3 (1995): 32-38.

Keywords: Mathematics, Attitudes and expectations, Experience

Study of the extent to which experience with and attitudes toward math differed by gender and of the association between math and computer attitudes among adolescents. Males completed more math courses, were more interested in math, and had more confidence in the math ability than females. Math liking and confidence were positively associated with interest in computers and computer confidence.

---. "Gender-Based Differences in Attitudes toward Computers." Computers and Education 20.2 (1993): 169-81.

Keywords: Counselors, Attitudes and expectations, Parents and home, Peers and friends, Teachers and faculty, Stereotypes and bias, Secondary/high school

1,754 9th and 12th graders were studied about their computer attitudes. Boys were significantly more positive about computers than girls, and slightly more so in 9th than 12th grade. Girls were likely to believe in the equality of both sexes for participating in computer activities, although boys were more likely to see computing as a man's field. There was no sex difference in the usefulness of computers. However, girls had much lower confidence in their ability to use computers, so they differentiate between their own ability and the ability of other females ("we can but I can't"). Students of both sexes in both grades agreed that teachers, counselors, and parents all believe that computers are more appropriate for males than females and that these socializers supported males more than females in terms of computing, but felt their peers (gender not known) did not hold sex-typed views. Students' interest in computers correlated with the amount of encouragement they reported receiving from parents, teachers, and counselors. Females' low computer self-confidence strongly correlated with their perceived fathers' belief that the computer was more appropriate for males than females. Low self-confidence is assumed to be a factor leading to females' low expectations for a role in computing, which is itself an outcome of gender socialization.

---. "Socioeconomic Status, Parents' Sex-Role Stereotypes, and the Gender Gap in Computing." Journal of Research on Computing in Education 26.4 (1994): 433-51.

Keywords: Attitudes and expectations, Parents and home, Race, ethnicity, or SES, Secondary/high school, Stereotypes and bias

1,730 9th and 12th graders were studied in 1991-92 to determine the effect of family SES and parental sex-typed views and behaviors on children's attitudes toward computers. They were surveyed about computer attitudes and their perceptions of their parents gender-relevant attitudes and encouragement/discouragement about computers. Students were asked about parents' occupations and education, which were used to define SES. Both boys and girls believed that their parents felt that computers were more appropriate for boys, and boys reported more parental encouragement. Students' perception of their parents' beliefs and encouragement affected their own interest, confidence, and stereotyped views of computers. Fathers' and mothers' male/computer belief encouraged boys and discouraged girls, and also promoted their childrens' stereotypes about computer users. 67% of the boys reported parental encouragement to take computing, while only 22% of the girls reported it. Students whose parents encouraged them "to take computer courses were more interested in computing, had less stereotypical views about computer users, and had more confidence in working with computers." (p. 441) SES had more influence on females than males. Higher SES mothers had daughters with less gender-stereotyped views about computing and more positive computer attitudes. However, "parental attitudes and encouragement substantially overshadowed the effect of SES on children's computer attitudes." (p. 447)

Shashaani, Lily, and Ashmad Khalili. "Gender and Computers: Similarities and Differences in Iranian College Students' Attitudes toward Computers." Computers and Education 37.3-4 (2001): 363-75.

Keywords: Attitudes and expectations, Outside U.S., Experience, Parents and home, Stereotypes and bias, Race, ethnicity, or SES

375 Iranian students majoring in science, social science or engineering at two universities in Tehran were surveyed in 2000 about computer attitudes. The sexes were equal on computer liking. In terms of stereotypes, females agreed strongly that both sexes are equally competent computer users; males still perceived computers as a male field. Nevertheless, females expressed low self-confidence in their own computer abilities. More males reported parental encouragement to study

computers. Peers' opinions supported gender equality in computing but did not correlate with subjects' attitudes. Female students who perceived that their mothers and fathers considered computers more appropriate for males were less confident in their ability. Fathers' stereotyped ideas about computer users strongly increased sons' and daughters' own stereotypes, especially sons. Parental encouragement correlated with positive student attitudes. ***SES****: Parental education had a stronger effect on students' attitudes than parental occupations, and more so for females than males. The higher the parents' educational level, the greater their daughters' interest in computers. Higher-status occupations and higher education levels of parents were associated with less gender stereotyping of computers.* ***Conclusion****: desire for computer learning in Iran is not gender-specific, as opposed to the U.S.*

Shaw, Graham, and Nigel Marlow. "The Role of Student Learning Styles, Gender, Attitutdes, and Perceptions on Information and Communication Techology Assisted Learning." Computers and Education 33 (1999): 223-34.

Keywords: Attitudes and expectations, Postsecondary/tertiary

99 undergraduate students were studied for the effect of learning styles (activist, reflector, theorist, or pragmatist) on attitudes toward ICT. No significant difference in learning style was found between the sexes. Experience was correlated with positive computer attitudes. Students whose learning style was "theorist" (people who attempt to fit their observations into a logical model or theory, and learn best when required to understand complex problems) tended to have the most negative computer attitudes.

Sherman, Richard C. et al. "The Internet Gender Gap among College Students: Forgotten but Not Gone?" CyberPsychology and Behavior 5 (2000): 885-94.

Could not obtain: not reviewed.

Shih, Margaret, Todd L. Pittinsky, and Nalini Ambady. "Stereotype Susceptibility: Identity Saleince and Shifts in Quantitative Performance." Psychology of Women Quarterly 10.1 (1999): 80-83.

Keywords: Stereotype threat

In an experiment with Asian-American women taking a math exam, when their Asian identity was salient they performed best; when their female identity was salient they performed worst; and when neither identity was salient (= control group) they performed in the middle.

Siann, Gerda. "We Can, We Don't Want To: Factors Influencing Women's Participation in Computing." Women in Computing. Eds. R. Lander and A. Adam. Exeter, UK: Intellect Books, 1997.

Could not obtain: not reviewed.

Siann, Gerda, Alan Durndell, Hamish Mcleod, and Peter Glissov. "Stereotyping in Relation to the Gender Gap in Participation in Computing." Educational Research 30.2 (1988): 98-103.

Keywords: Stereotypes and bias, Attitudes and expectations, Postsecondary/tertiary, Outside U.S.

928 university students in Edinburgh were randomly assigned questionnaires describing a female computer scientist, with the other half getting an otherwise identical male computer scientist. On eight of the attributes (more self-reliant, fun to be with, independent, approachable, likeable, sympathetic, well-adjusted, popular, and less introverted), Karen was rated more positively than Kevin (higher in introverted and serious), an effect held respective of the sex of the rater or the subject studied by the rater. "Negative stereotyping of female computer scientists is becoming increasingly less likely." (p. 98)

Siann, G., H. Macleod, P. Glissov, and A. Durndell. "The Effect of Computer Use on Gender Differences in Attitudes to Computers." Computers and Education 14.2 (1990): 183-91.

Keywords: Single-sex environment, Attitudes and expectations, Programming, Elementary/primary, Outside U.S.

Primary school children in Scotland were studied at Logo programming in pairs. Half used list processing and half used graphic processing. Some pairs were single sex and others were mixed. In the pretest, boys were more confident of their computer skills, had more interest in computers, and were likelier to believe that computing required high ability. After the intervention, gender differences in attitudes diminished, except that girls' anxiety levels relative to boys increased. Neither the programming approach nor the sex composition of the dyad made a difference. Observations indicated that in mixed-sex dyads the boys dominated.

Singh, Parlo. "Institutional Discourse and Practice: A Case Study of the Social Construction of Technological Competence in the Primary Classroom." British Journal of Sociology of Education 14.1 (1993): 39-58.

Keywords: Culture, Elementary/primary, Outside U.S.

A primary classroom in Australia was studied. The boys' control over power/relations in the computer setting is strengthened by the support of the classroom teacher, who acknowledges the boys' claim to computer experience. The behavior of boys in this social construction is interpreted as risk-taking, experimental, and technologically competent. Girls are positioned as inactive, passive, and rule followers.

Skyllingstad, Devon. An Exploration into the Lack of Female High School Students in Computer Science. n.d. Available: http://cerebro.cs.xu.edu/~devon/crew/formattedghc.pdf, retrieved November 8, 2004.

Keywords: Attitudes and expectations, Interventions, Age, Secondary/high school

Surveys of high school students in the Cincinnati (Ohio) area found that males and females had about the same skill level. However, students felt that males are more encouraged in CS than females, that girls lose interest in CS as they get older, and that girls perceived CS as a predominantly male field. While fewer females were interested in majoring in CS, a larger percentage of those who were said they had been explicitly encouraged, so encouragement is important. Females with higher computer self-confidence were more likely to be interested in a CS major.

Slesnick, Twila. "Software for Girls: A Sexist Solution?" World Conference on Computers in Education. Ed. K. Duncan and D. Harris. Norfolk, VA, 1985. 839-41.

Keywords: Software

Software developed just for girls would be sexist software. What is needed is software that appeals equally to boys and girls.

Smith, L. "Have We Closed the Gaps in Student Computer Use?" The Computing Teacher 17 (1989): 37-39.

Could not obtain: not reviewed.

Smith, Lola B. "The Socialization of Females with Regard to a Technology-Related Career: Recommendations for Change." Meridian: A Middle School Computer Technologies Journal 3.2 (2000).

Keywords: Career factors, Curriculum, Role models and mentors, Peers and friends, Interventions, Adults

12 women who took technological career paths were asked via interviews, observations and document analysis about influences on their career choice. They mentioned role models, encouragement ("scaffolding"), collaborative assignments, reality-based assignments, and encouragement from father, male peers and male siblings. Recommended interventions include encouraging girls to ask questions and take risks and increasing play activities in technology environments.

Smith, Sara Dawn. "Computer Attitudes of Teachers and Students in Relationship to Gender and Grade Level." Journal of Educational Computing Research 3.4 (1987): 479-94.

Keywords: Attitudes and expectations, Teachers and faculty

In a district-wide study of teachers and students, females showed stronger feelings for equity in computer use and careers than males. Teachers showed significantly higher attitudes favoring equality of the sexes in computer abilities and potential for computer careers than students did.

Smith, S.D. "Relationships of Computer Attitudes to Sex, Grade Level, and Teacher Influence." Educational Studies 106.3 (1986): 338-44.

Could not obtain: not reviewed.

Snyder, Thomas D., Alexandra G. Tan, and Charlene M. Hoffman. Digest of Education Statistics 2003. Washington DC: U.S. Department of Education, Institute of Education Sciences, 2004.

Keywords: Statistics, Use patterns, Telecommunications

Student computer use in the U.S. is now mostly equal. Internet: equal until college, when females use it more. (Table 426) Home computer use: essentially equal. (Table 429) School computer use: Essentially equal until college, when males use it more: financial reasons? (Table 429) Home computer use for schoolwork: slightly more females. (Table 429). However, high school computer courses taken: essentially equal until 1994, now (= 2001) the most unequal it has been since data were collected on this in 1982, with boys taking an average of 0.93 Carnegie Units and girls, 0.74. (Table 137)

Degrees in CS earned by women 2001: Associates, 40.5%, Table 263; Bachelors, 27.6%, Table 264; Masters, 33.9%, Table 269; Ph.D., 22.8%, Table 271

Solomou, K. "Nursery School Children and Computers: Gender-Related Differences." Unpublished dissertation. University of Sheffield, 1996.

Keywords: Parents and home, Elementary/primary, Preschool, Outside U.S.

Parents in England were studied who visited their children's nursery schools. Both mothers and fathers were more likely to ask questions about their sons' use of computers than their daughters'.

This source was cited in Opie, Clive (1998). "Whose turn next? Gender issues in information technology" in Gender in the Secondary Curriculum: Balancing the Books *(Ann Clark & Elaine Millard, eds.). London: Routledge, p. 83.*

Solvberg, Astrid M. "Gender Differences in Computer-Related Control Beliefs and Home Computer Use." Scandinavian Journal of Educational Research 46.4 (2002): 409-26.

Keywords: Attitudes and expectations, Middle school, Outside U.S.

In a study of Norwegian 8th graders, a group of students who did not use computers in school was found to show higher male confidence and perceived control of the computer. Another group that did use computers in school showed no gender differences. (Reviewed abstract only)

Sorenson, Knut et al. Case Studies of Public Efforts to Include Women in Ict: Information Society Technologies, 2003.

Keywords: Cross-cultural, Interventions, Single-sex environment, Adults, Role models and mentors, Outside U.S.

The report deals with 15 initiatives on gender and technology in Norway, the Netherlands, Scotland, Italy, and Ireland. "One major provisional finding is, on the basis of cases in training and education, that successful inclusion is based on projects that combine a measure of different strategies. That is, recruitment, teaching methods, role models, social support, practical assistance and financing are important factors that should be combined." (p. 15-16) In some projects, single-sex courses were successful, but in others the women "do not want 'self-consciousness training.'" (p. 16)

*In one **Norway** project, interviews with teachers found that many teachers resented the government's emphasis on gender equity and felt that such an emphasis was old-fashioned and no longer necessary; in schools that did not emphasize gender equity girls were included anyway. In a second Norway project at the Norwegian University of Science and Technology, female enrollment in ICT dropped from 20% in the mid-80s to 6% in the mid-90s; the Women in Computing Initiative gave women info about the major, convinced able women to apply, set quotas for women, reformed the curriculum, improved the quality of teaching, and improved the social environment. They felt there was no single intervention that produced the successful result, but rather the combination. In a **Dutch** project that targeted training for adult women returning to the job market, they emphasized flexibility in educational routes and entry points, attention to women's personal situations, and emphasis on labor market realities. In a single-sex project in **Scotland** for disadvantaged unemployed women, the women attended school 3 days a week with 1/2 day on personal development and communication with the rest on IT; tuition, travel, and childcare were free. The majority of the graduates found employment or continued in higher education. In another Scots project that worked with teachers, teachers showed little awareness that there may be gender differences in ICT use and confidence among children they teach. In **Ireland**, one project focused on providing role models for girls. In **Italy** all projects were focused on adult women.*

Spear, Margaret Goddard. "Teachers' Attitudes Towards Girls and Technology." Girl-Friendly Schooling. Eds. Judith Whyte, Rosemary Deem, Lesley Kant and Maureen Cruickshank. London: Methuen, 1985. 36-44.

Keywords: Teachers and faculty, Attitudes and expectations, Outside U.S., Stereotypes and bias

215 teachers in southern England. including a large group of science teachers, indicated they believed that technology education was more important for boys than girls.

Spencer, Steven J., Claude M. Steele, and Diane M. Quinn. "Stereotype Threat and Women's Math Performance." Journal of Experimental Social Psychology 35.1 (1999): 4-28.

Keywords: Stereotype threat

In several experiments, they found that women underperform on difficult math tests, but not on easy ones, in a stereotype threat condition. The underperformance is eliminated when the stereotype threat is removed.

Spertus, Ellen. Why Are There So Few Female Computer Scientists? Cambridge, MA: MIT Artificial Intelligence Laboratory, 1991.

Keywords: Culture, Attitudes and expectations, Language and terminology

Sex-role stereotyping in society, the computer culture, and in technical language.

---. "Wit Helps Women in Computer Science Combat Ignorance." CPSR Newsletter 18.1 (2000).

Keywords: Attitudes and expectations, Postsecondary/tertiary,

Women in technology in higher education, both students and faculty, must deal with the expectations of many others that they should be like men.

Spotts, Thomas H., Mary Ann Bowman, and Christopher Mertz. "Gender and Use of Instructional Technologies: A Study of University Faculty." Higher Education 34.4 (1997): 421-36.

Keywords: Teachers and faculty, Experience, Use patterns, Barriers, Postsecondary/tertiary

Male and female faculty at a midwestern public university were studied. Males rated their knowledge and experience with some innovative technologies higher than women did, though there was no difference in frequency of use. Women were more likely to cite these factors as influencing technology use: time to learn it, increased student learning, ease of use, training, and available information. Women were more likely than men to cite lack of time and lack of contribution to professional advancement as barriers. (Reviewed abstract only)

Sproull, Lee, David Zubrow, and Sara Kiesler. "Cultural Socialization to Computing in College." Computers in Human Behavior 2 (1986): 257-75.

Keywords: Culture, Postsecondary/tertiary

Freshmen at two universities were surveyed about their responses to CS courses vs to other courses. They were more likely to report "reality shock, confusion, control attempts, anger, and withdrawal" (p. 257) in their CS courses than the others. Feelings were more negative in the teaching university as opposed to the research university, in females, in students who had not taken a computing course in high school, and students who were not majoring in science or engineering. However, "even male, experienced, engineering, and science students encountered computing as an alien culture." (p. 257)

Starr, Linda. An Education World E-Interview with Sherry Turkle: Is Technology Just for Boys? 2000. Available: http://www.education-world.com/a_curr/curr228.shtml. October 11, 2001.

Keywords: Curriculum

"[G]irls are not afraid [of computers] but ... they are uninspired and alienated by the way K-12 education presents computing to them." Computing should be present throughout the curriculum. The curriculum must be flexible enough to accommodate people's different paths to technology.

Steele, Claude M. "A Threat in the Air: How Stereotypes Shape Intellectual Identity and Performance." American Psychologist 52.6 (1997): 613-29.

Keywords: Stereotype threat

The original article on stereotype threat. Immensely important for gender and IT.

Steele, Maggie. "Using Music to Increase Interest in Computers for Girls and Minorities." Teaching and Change 4.4 (1997): 293-311.

Keywords: Curriculum, Elementary/primary

An elementary school teacher used a computer-based music composition program to interest girls and children of color in the computer. They all liked it.

Stumpf, Heinrich, and Julian C. Stanley. "The Gender Gap in Advanced Placement Computer Science: Participation and Performance, 1984-1996." College Board Review.181 (1997): 22-27.

Keywords: Secondary/high school, Enrollments, Mathematics, Advanced Placement

In a study of Advanced Placement CS exams AB (since it started in 1984) and A (when it started in 1991) through 1996, it was found that the percentage of girls taking the test decreased in both exams and that males consistently outperformed females throughout. In both exams the gender difference in the scores decreased fairly steadily over the years, so that now it is smaller than before. This pattern is different from the math and science pattern where gender differences in scores tended to be rather stable over the years. "Clearly, strong efforts should be made so that computer science, which is critically important for many academic specialties and for social progress, will be more attractive to women." (p. 27)

Sturm, Deborah, and Marsha Moroh. "Encouraging Enrollment and Retention of Women in Computer Science Classes." National Educational Computing Conference. Boston, 1994.

Keywords: Interventions, School programs, Postsecondary/tertiary

Women computer science students at the College of Staten Island in New York City had higher pass rates than male peers, but their enrollment and retention rates were low. Paper describes various features of a program designed to increase them: brochure of CS career benefits, tutoring workshops, seminars for potential female majors, and mentoring/role models. No outcomes are presented.

---. "Gender and Computer Science Majors: Perceptions and Reality." National Educational Computing Conference. Baltimore, 1995.

Keywords: Stereotypes and bias, Mathematics, Attitudes and expectations, Postsecondary/tertiary

An analysis of the transcripts of computer science majors at the College of Staten Island in New York City over five years, when women were 28% of the total enrollment. Women performed as well as men in the courses and outperformed them at every level of mathematics. A survey of current students, however, revealed that both sexes believed that men surpassed women in calculus.

Sullivan, Patrick. "Gender Differences and the Online Classroom: Male and Female College Students Evaluate Their Experiences." Community College Journal of Research and Practice 25.10 (2001): 805-18.

Keywords: Telecommunications, Distance education, Postsecondary/tertiary

Community college students were questioned about their experience with online courses. Adult female students with children or family responsibilities were especially likely to value the experience. (Reviewed abstract only)

Sutton, Rosemary E. "Equity and Computers in the Schools: A Decade of Research." Review of Educational Research 61.4 (1991): 475-503.

Keywords: Research review, Race, ethnicity, or SES, Access, Use patterns, Attitudes and expectations, Teachers and faculty, Curriculum, Classroom interactions, Single-sex environment, Software

A review of research conducted in the 80s on computer equity in terms of race/ethnicity, gender, and social class. Inequalities in access are documented. Five process factors are considered: 1) type of use (girls' under-representation in programming, games, and before/after-school use), 2) teachers' attitudes (biased in favor of boys), 3) media (computer magazines showed males), 4) curriculum content (software content), and 5) interactions among students (overenthusiastic boys, solo/group computer use, single-sex/mixed groups — mixed results for the latter). Three outcome variables are considered: student attitudes (some studies reported higher male attitudes, others no difference), computer competence (differences in literacy but not programming competence), and computer-aided instruction achievement. Among the conclusions: computer use in education has "maintained and exaggerated inequities." (p. 475)

---. "Equity Issues in Educational Computer Use." New Zealand Computers in Education Society. New Plymouth, New Zealand, 1989.

Keywords: Interventions, Outside U.S.

Recommends strategies for computer equity: awareness, access, more equitable use patterns and curriculum materials, role models, career awareness, cooperative learning, and Logo over BASIC.

Swadener, Marc, and Michael Hannafin. "Gender Similarities and Differences in Sixth Graders' Attitudes Towards Computers: An Exploratory Study." Educational Technology (1987): 37-42.

Keywords: Attitudes and expectations, Mathematics, Elementary/primary

Study was to see if there were differences in 6th graders with high and low math achievement and their attitude toward computers. All groups felt that there was no sex difference in the likelihood of success with computers.

Swadener, Marc, and Karen Jarrett. "Gender Differences in Middle Grade Students' Actual and Preferred Computer Use." Educational Technology (1986): 42-47.

Keywords: Use patterns, Parents and home, Elementary/primary, Middle school

259 4th through 8th graders were surveyed. Use: for 80% of the sample use levels were similar by sex, but about 20% of the boys reported heavy computer use. More boys (50%) than girls (35%) owned home computers; again boys were the heaviest users. Both boys and girls preferred games and content software. Most of the gender difference is due to a small percentage of boys who use the computer much more than girls and most boys.

Swain, Sandra L., and Douglas M. Harvey. "Single-Sex Computer Classes: An Effective Alternative." Tech Trends 46.6 (2002): 17-20.

Keywords: Single-sex environment, Research review, Access, Interventions, Attitudes and expectations, Classroom interactions

Short review of the research on how single-sex technology classrooms might help with gender problems: accessibility, attitudinal differences, achievement, and classroom learning environment. Although single-sex classrooms "do not mirror the real world females must contend with once outside the classroom, they are, however, effective interim interventions to enable females to lessen the current technology gap." (p. 19)

Tarlin, Ellen. "Computers in the Classrooms: Where Are All the Girls?" Harvard Educational Review Focus series.3 (1997).
Could not obtain: no review.
Taylor, Harriet G., and Luegina Mounfield. "An Analysis of Success Factors in College Computer Science: High School Methodology Is a Key Element." Journal of Research on Computing in Education 24.2 (1991): 240-45.
Keywords: Secondary/high school, Postsecondary/tertiary, Programming, Parents and home
High school experience with programming was the major component of high school computer experience that contributed the most to success in IT in college. Programming courses were especially helpful, as opposed to learning programming on one's own in an undisciplined fashion. Higher grades in programming class were predictive of college success. Knowing applications only without programming was not an indicator of college computer science success. Home computer ownership had a very small positive effect on college CS success.
---. "Exploration of the Relationship between Prior Computing Experience and Gender on Success in College Computer Science." Journal of Educational Computing Research 11.4 (1994): 291-306.
Keywords: Programming, Parents and home, Secondary/high school, Postsecondary/tertiary
In a study of 656 college students, males' college CS success was correlated with owning a computer and having taken high school programming courses. For females, however, having taken high school programming course, having their own computer, and having had any prior computing experience correlated with college CS success. High school CS courses were almost four times more predictive of female success in college than male success.
Teague, Joy. "Raising the Self-Confidence and Self-Esteem of Final-Year Students Prior to Job Interviews." SIGSCE Bulletin 24.1 (1992): 67-71.
Could not obtain: not reviewed.
---. "Women in Computing: What Brings Them to It, What Keeps Them in It?" SIGCSE Bulletin 34.2 (2002): 147-58.
Keywords: Career factors, Research review
In a study of 15 women working in computing, it was found that they enjoy the work they are doing, and that dislikes were more likely to be associated with people and politics. The paper reviews the literature on female career choice in computing.
Teh, George P.L., and Barry J. Fraser. "Development and Validation of an Instrument for Assessing the Psychosocial Environment of Computer-Assisted Learning Classrooms." Journal of Educational Computing Research 12.2 (1995): 177-93.
Keywords: Methodology, Outside U.S.
A new instrument was developed with four subscales — investigation, innovation, resource adequacy, and gender equity. The first three were adapted from other instruments but the gender equity subscale was created for this instrument. It was tested with students in Singapore. Using the instrument it was found that using a computer in class reduced gender inequity, perhaps because in a computerless classroom the teacher is the main source of information and help and girls get less of this resource. The instrument is appended.
Temple, Linda, and Hilary M. Lips. "Gender Differences and Similarities in Attitudes toward Computers." Computers in Human Behavior 5 (1989): 215-26.
Keywords: Postsecondary/tertiary, Attitudes and expectations, Mathematics, Career factors, Culture
Attitude surveys of university students revealed no gender differences in personal interest in and enjoyment of computers, but differences were found favoring males in computer knowledge, course experience, career intentions, confidence, and positive attitudes toward mathematics. Women's apparent inhibition from persistence in IT "may be linked to their anxiety about their own skills and the communication, by male peers, of the attitude that women are less capable than men of learning about computers." (p. 215)
Thomborson, Clark. Cs Gender Gap Still a Problem. 1995. Web. Available: http://www.cra.org/CRN/html/9511/expanding/ct.2_2_5.shtml, retrieved December 28, 2004.
Keywords: Pipeline, Postsecondary/tertiary, Teachers and faculty
CS professor: "Over the past decade, gender balance at the undergraduate level in computer science has steadily deteriorated in the United States. I don't like the current situation in the undergraduate classroom, and I am afraid of what it portends for gender balance at the faculty level in the future. My motivation: I don't want to work in a gender-segregated workplace for the

rest of my life." CS is the only discipline in science and engineering to show a downward trend in high school females' interest.

Thurston, Linda P. "Girls, Computers, and Amber Waves of Grain: Computer Equity Programming for Rural Teachers." National Women's Studies Association. Towson, MD, 1989.

Keywords: Teacher education, Teachers and faculty

A year-long in-service training program for rural teachers in Kansas was designed to help teachers provide gender-equitable computer education to elementary and middle-school students. In addition to computer skills, gender equity was taught using "The Neuter Computer" by Sanders & Stone (1986). Control-group evaluation showed that teachers had more equitable attitudes and female students showed increased use and enjoyment of the computer.

Tillberg, Heather K., and J. McGrath Cohoon. "Attracting Women to the Cs Major." Frontiers: A Journal of Women Studies 26.1 (2005).

Keywords: Attitudes and expectations, Postsecondary/tertiary, Culture

Focus groups of CS majors in college revealed that men and women were largely attracted to CS by similar factors: positive early experiences, positive initial academic experience, encouragement from adults and peers, love of mathematics, logic, and programming; belief that abilities matched discipline requirements, and expectation of desirable career opportunities. Women were more likely to be interested in computers to enrich human experience and for usefulness, and some women were stimulated by the challenge of succeeding in a male-dominated environment — "a contrary, I'll-prove-you-wrong type of attitude" might not be needed when more women enter CS.

Todman, John. "Gender Differences in Computer Anxiety among University Entrants since 1992." Computers and Education 34.1 (2000): 27-35.

Keywords: Attitudes and expectations, Postsecondary/tertiary

Studies of first-year university students between 1992 and 1998 as computers became more widely available showed a reduction in levels of computer anxiety. However, there was a widening gap in computer anxiety between female and male students with the proportion of computer-anxious women increasing and computer-anxious men decreasing.

Torkzadeh, Reza, Kurt Pflughoeft, and Laura Hall. "Computer Self-Efficacy, Training." Behavior and Information Technology 18.4 (1999): 299-309.

Keywords: Attitudes and expectations, Postsecondary/tertiary

University business students were surveyed pre and post an introductory computer course. While both males and females showed improved computer self-efficacy, the course was less effective with people with negative attitudes toward computers. (Reviewed abstract only)

Townsend, Gloria Childress. "People Who Make a Difference: Mentors and Role Models." SIGCSE Bulletin 34.2 (2002): 57-61.

Keywords: Role models and mentors, Interventions

The paper accepts the results of research studies that "steadfastly and uniformly" have advocated the use of mentors and role models for recruiting and retaining women in computer science. It describes advice for using mentors and role models.

Treu, Kevin, and Alisha Skinner. "Ten Suggestions for a Gender-Equitable Cs Classroom." Journal of Computing in Small Colleges 12.2 (1996): 244-48.

Keywords: Pedagogy, Postsecondary/tertiary, Classroom interactions

Ten suggestions are presented (without a research basis) for creating a more nurturing environment for women in computer science. 1. Address female students by name as often as men are addressed by name. 2. Establish eye contact equally. 3. Avoid gesturing more often when men respond to questions or make comments. 4. Refrain from interrupting female students more often than males. 5. Allow women as much time to answer questions as men. 6. When a woman can't answer a question, do not regularly go to a man with the assumption of getting the correct answer. 7. Offer hands-on experience and spend time teaching the basics to reduce anxiety throughout. 8. Explain the relevance of labs, assignments, and lecture material to other areas or disciplines. 9. Discuss ethical issues in computing. 10. Emphasize the positive social benefits of computing.

Tsai, Meng-Jung. "Do Male Students Often Perform Better Than Female Students When Learning Computers? A Study of Taiwanese Eight Graders' Computer Education through Strategic and Cooperative Learning." Journal of Educational Computing Research 26.1 (2002): 67-85.

Keywords: Attitudes and expectations, Context, Outside U.S.

Boys exhibited more computer anxiety than girls, and both sexes showed more computer anxiety in cooperative learning environments. (Abstract only)

Turkle, Sherry. The Second Self: Computers and the Human Spirit. New York: Simon & Schuster, 1984.

Keywords: Attitudes and expectations

Boys tend to be hard masters, the imposition of will over the machine through the implementation of a plan, while soft mastery — typically exhibited by girls — is more interactive. Girls "tend to see computational objects as sensuous and tactile and relate to the computer's formal system not as a set of unforgiving 'rules,' but as a language for communicating with, negotiating with, a behaving, psychological entity." (pp 108-109)

Turner, Sandra V., Phyllis W. Bernt, and Norma Pecora. "Why Women Choose Information Technology Careers: Educational, Social, and Familial Influences." American Educational Research Association. New Orleans, 2002.

Keywords: Career factors

A survey of Systers listserv members found that women followed multiple academic paths to their current IT positions. 12% had undergraduate and graduate IT degrees, 31% had undergrad IT degrees and other graduate majors; 14% had a non-IT but technical undergrad major and a non-technical, non-IT grad major (if any); and 31% had an arts, social sciences or humanities undergrad major a non IT, non-technical graduate major (if any). So two thirds of the women took a nontraditional career path without majoring in IT as an undergraduate.

Underwood, Geoffrey, and Nishchint Jindal. "Gender Differences and Effects of Co-Operation in a Computer-Based Language Task." Educational Research 36.1 (1994): 63-74.

Keywords: Single-sex environment

Single-sex and mixed-sex pairs of children were given a language task at the computer that required cooperative keyboard use. Half the pairs across all conditions were instructed to work cooperatively while the other half were told they would be assessed individually. Instructions to cooperate had no effect on the female pairs, which did so regardless of the instructions. They had no effect on mixed-sex pairs, which showed little evidence of cooperative working despite the instructions. They had the greatest effect on male single-sex pairs because they effectively changed the working style.

Underwood, Geoffrey, Michelle McCaffrey, and Jean Underwood. "Gender Differences in a Cooperative Computer-Based Language Task." Educational Research 32.1 (1990): 44-49.

Keywords: Single-sex environment

Children in an upper primary school were divided into single-sex and mixed-sex pairs, with a control group of children working individually, and given a language task that required cooperative use of the keyboard. Male and female pairs did better than children working alone, but mixed-sex pairs did not. Classroom observations suggested that children in single-sex pairs shared task components and discussed possible solutions, while children in mixed-sex pairs tended to separate the task components and work according to each other's instructions.

Vale, Colleen M., and Gilah C. Leder. "Gender and Attitudes to Computer Use in Junior Secondary Mathematics." Mathematics Education Research Group of Australasia. Eds. L. Bragg, C. Campbell, G. Herbert and J. Mousley. Geelong, Australia: MERGA, Geelong AU, 2003. 680-87 of MERINO: Mathematics Education Research: Innovation, Networking, Opportunity.

Keywords: Mathematics, Attitudes and expectations, Outside U.S.

Secondary students in two classrooms in Australia were studied. For both girls and boys, attitude to the use of computers in mathematics was more strongly associated with their attitudes to computers than attitudes toward mathematics.

---. "Student Views of Computer-Based Mathematics in the Middle Years: Does Gender Make a Difference?" Educational Studies in Mathematics 56.3 (2004): 1-26.

Keywords: Mathematics, Attitudes and expectations, Outside U.S.

Middle-school students in Australia were studied. Girls viewed the computer-based math lessons less favorably than did boys. Boys were likelier to believe that computers contributed to experiencing pleasure in the lessons and to making math more relevant to them. Girls were more concerned about whether computers facilitated learning and led to success in math.

Valian, Virginia. Why So Slow? The Advancement of Women. Cambridge, MA: MIT Press, 1998.

Keywords: Classroom interactions, Teachers and faculty

Gender schemas about males and females cause us to expect men to do well and see their performance in the rosy light of our expectations, and vice versa for women. These inadvertent and often unconscious tiny male advantages and female disadvantages add up to a powerful accumulated difference.

van Braak, Johan P. "Domains and Determinants of University Students' Self-Perceived Computer Competence." Computers and Education 43.3 (2004): 299-312.

Keywords: Methodology, Attitudes and expectations, Postsecondary/tertiary

An instrument on self-perceived computer competence was developed. Univariate gender differences in computer competence seem to disappear when controlled for computer confidence: girls felt less confidence than boys.

Vasil, Latika; Hesketh, Beryl & Podd, John. "Sex Differences in Computing Behaviour among Secondary School Pupils." New Zealand Journal of Educational Studies 22.2 (1987): 201-14.

Keywords: Attitudes and expectations, Experience, Parents and home, Outside U.S., Secondary/high school

Secondary students in New Zealand were surveyed. There were no sex differences in intention to enroll in a computer course, but there were strong sex differences favoring boys in access to computers, access to home computers, frequency of use, past computer experience, and self-efficacy expectations.

Vegso, Jay. "Interest in Cs as a Major Drops among Incoming Freshmen." Computing Research News 17.3 (2005).

Keywords: Pipeline

With data from the Higher Education Research Institute at the University of California at Los Angeles, article shows alarming drop in freshmen's interest in computer majors, especially among women, whose interest "has fallen to levels unseen since the early 1970s." Great charts from 1960s and 1970s to 2004.

VOICE: Vocational Options in Creating Equality. Computer Equity: Access Is Not the Problem. Albany: Regional Planning Center, Albany-Schoharie-Schenectady BOCES, 1986.

Keywords: Access, Barriers

Article lists barriers from the Computer Equity Expert Project to girls' success with computers.

Volk, Ken, and Lilla Holsey. "Tap: A Gender Equity Program in High Technology." The Technology Teacher.1 (1997): 10-13.

Keywords: Interventions, Secondary/high school, Extracurricular programs

The Technology Adventures Program in North Carolina held a summer institute for high school girls in 1994 through 1996. Students learned about various aspects of technology from professors, had field trips, recreational activities, and student counselors. At the conclusion of each institute, students said they were more likely than before to be involved with technology.

Volman, Monique. "Care, Computers and the Playground: Gender and Identity in Education." Discourse 18.2 (1997): 229-40.

Could not obtain: not reviewed.

---. "Computer Education as a Gender Relationship: Deconstructing the Dilemma of Girl-Friendly Education." Fourth Interdisciplinary Congress on Women. New York, 1990.

Keywords: Single-sex environment, Interventions, Stereotypes and bias

"So-called girl friendly courses run the risk of falling into the same trap as many regular computer courses, assuming a problematic relationship between women and computers. ... [I]ntervention programmes, which assume that females 'naturally' dislike or lack ability for computer education, are probably counterproductive. Yet, only the existence of a problem provides the special courses for women with a right to exist." (p. 1) Many of the special courses are based on gender stereotypes, a dilemma well known in women's studies. Regular computer courses often make girls lose interest in computing, but special courses or teaching methods often reproduce gender stereotypes. The opposition of females and computing is often assumed but is the product of historical and cultural context. Many intervention programs use as their main strategy the incorporation of female interests as well as male interests, and in so doing they perpetuate gender differences.

---. "Gender-Related Effects of Computer and Information Literacy Education." Journal of Curriculum Studies 29.3 (1997): 315-28.

Keywords: Pedagogy, Attitudes and expectations, Outside U.S., Secondary/high school

Computers were introduced in the Netherlands in 1993-94 in lower secondary education. After the course sex differences in computer knowledge diminished as compared to before, but the course was not able to remove prior sex differences in attitudes. Moreover, students who worked with a non-gender-inclusive method showed an increase in sex differences in computer attitudes. In other words, there was cognitive but not affective improvement. Gender-inclusive methods: a lit review yielded a list of pedagogical characteristics thought to constitute "gender-inclusive teaching" — content, context, teaching methods, and hidden curriculum, most with sub-components. Classes were observed and evaluated based on this list.

Volman, Monique, and Edith van Eck. "Gender Equity and Information Technology in Education: The Second Decade." Review of Educational Research 71.4 (2001): 613-34.

Keywords: Research review, Access, Use patterns, Attitudes and expectations, Curriculum, Classroom interactions

Topics covered: Process: access, use patterns, teachers' attitudes and behavior, curriculum, student interactions, approach (= gendered learning style). Outcomes: student attitudes, competence, computer-aided instruction. She noted that computer attitudes are both a cause and a consequence of differences in ICT participation and performance of girls and boys.

Walker, Ellen, and Susan Roger. "Pipelink: Connecting Women and Girls in the Computer Science Pipeline." National Educational Computing Conference. Minneapolis, 1996.

Keywords: Retention, Interventions, Extracurricular programs, Role models and mentors, Teacher education

A program sought to retain women in CS in high school through the Ph.D. by a variety of activities including role models, teacher training, support groups, presentations, electronic mentoring, a research program, and a summer program. There were no evaluation results.

Wallace, Andrew R., and Kenneth E. Sinclair. "Affective Responses and Cognitive Models of the Computing Environment." American Educational Research Association. San Francisco, 1995.

Keywords: Attitudes and expectations

Comparing teacher education students with CS majors, the female teacher ed students were found to be less confident with computers than their male peers. There were no gender differences among the CS majors.

Ware, Mary Catherine, and Mary Frances Stuck. "Sex-Role Messages Vis-a-Vis Microcomputer Use: A Look at the Pictures." Sex Roles: A Journal of Research 13.3/4 (1985): 205-14.

Keywords: Media

The study analyzed the pictorial representation of people in popular computer magazines. Men were shown about twice as often as women. Women were over-represented as clerical workers and sex objects; men were over-represented as managers, experts, and repair technicians. Women were shown more often in a passive role with respect to computers, and men more often in a position of authority. Only women were shown rejecting the computer or as sex objects.

Warren-Sams. Closing the Equity Gap in Technology Access and Use: A Practical Guide for K-12 Educators. Portland, OR: Northwest Regional Educational Laboratory (NWREL), 1997.

Keywords: Curriculum, Use patterns

Inequities in access, use, and curriculum. Checklists.

Wasburn, Mara H., and Susan G. Miller. "Still a Chilly Climate for Women Students in Technology: A Case Study." Women, Gender and Technology. Eds. Sue V. Rosser and Mary Frank Fox. Urbana-Champaign: University of Illinois Press, 2005.

Keywords: Classroom interactions, Attitudes and expectations, Teachers and faculty, Teacher education, Retention, Enrollments, Postsecondary/tertiary

As part of an effort to increase the essentially flat female enrollment in Technology at Purdue University despite an all-but-moribund Women in Technology student organization, the authors surveyed women enrolled. Women reported feeling isolated, that some professors did not treat men and women equally, that some of them did not feel comfortable going to professors for assistance outside the classroom, and that group projects with male students were often difficult. They felt that male students lacked respect for their ability, and that both male and female faculty needed education about issues concerning women students in mostly male classrooms. They saw role models and mentoring as critical. One woman wrote: "Don't worry so much about getting people to come to the school. Worry about what happens to us once we get here." Women

proposed steps the group could take to improve their situation. Technology faculty and grad student instructors agreed to a series of workshops on gender equity.

Weil, M., and L.D. Rosen. "The Psychological Impact of Technology from a Global Perspective: A Study of Technological Sophistication and Technophobia in University Students from Twenty-Three Countries." Computers in Human Behavior 11.3 (1995): 95-133.

Keywords: Cross-cultural, Attitudes and expectations, Outside U.S.

They found that men were significantly more anxious than women in Thailand, Italy, and Kenya, while women were more anxious than men in Israel and Hungary. There were significantly more male technophobes in Kenya and significantly more female technophobes in the USA, Hungary, and Australia. (cited in Galpin, 2002)

Weinman, Janice, and Pamela Haag. "Gender Equity in Cyberspace." Educational Leadership 56.5 (1999): 44-49.

Keywords: Policy

Discussion of the AAUW Technology Commission work to assess gender issues in technology for girls.

Welty, Kenneth. "Identifying Women's Perspectives on Technology." International Technology Education Association. Phoenix, Arizona, 1996.

Keywords: Career factors, Stereotypes and bias, Postsecondary/tertiary

Data was collected from 875 college students. Men described technology more than women in the context of work and associated it with ideas more than women. Women associated technology with computers and electronics more than men, and tended to equate technology with science more than men. Women also associated technology more with societal advancement than men did. In terms of careers, women tended to be interested in medical and communication technologies while men tended to be interested in automotive technology, computer technology, and automation.

Werner, Linda, Charlie McDowell, and Brian Hanks. Female Computer Science Students Who Pair Persist. Manuscript: paper to be submitted.

Keywords: Programming, Single-sex environment, Interventions, Attitudes and expectations, Retention, Postsecondary/tertiary

Describes pair programming: why and how, including implementation guidelines. Four sections of an introductory college programming course were studied, in which three sections were conducted using same-sex pairs. In the fourth students worked by themselves. Both women and men were about 9% more likely to complete the course if they worked in pairs rather than alone. A significantly higher percentage of students, both male and female, who paired in the intro course took the subsequent programming course than who did the intro course solo. Women who had paired were more likely to major in CS than women who had taken the intro course solo. Both men and women who had paired reported more confidence in their programming abilities.

Werner, Linda L., Jill Denner, and Steven Bean. "Pair Programming Strategies for Middle School Girls." Computers and Advanced Technology in Education. Kauai, Hawaii, 2004.

Keywords: Interventions, Extracurricular programs, Programming, Single-sex environment, Programming, Role models and mentors

Middle-school girls learned Flash programming working in pairs in an after-school and a summer program. To train girls in working in pairs, they used role modeling of effective and ineffective pair programming by having the teachers perform good and bad scripts, having girls identify pair programming rules, and publicly recognizing effective pair programmers of the week. Scripts and rules are included. No outcome measures.

Werner, Linda L., Brian Hanks, Harlie McDowell, Heather Bullock, and Julian Fernald. "Want to Increase Retention of Your Female Students?" Computing Research News 17.2 (2005).

Keywords: Single-sex environment, Attitudes and expectations, Interventions

About pair programming (two people of the same sex at one computer): more confidence, greater course completion and pass rates, more likely to persist. Especially helpful for women.

West, Margaret, and Susan Ross. "Retaining Females in Computer Science: A New Look at a Persistent Problem." Journal of Computing in Small Colleges 17.5 (2002): 1-7.

Keywords: Culture, Context,

Five female college students taking programming were interviewed. All reported they went to the instructor and not to male classmates for help. Half were comfortable in the male environment and half were not (intimidated, afraid to ask questions, felt the males excluded women). All five

expressed doubt about their ability to do computer science, which surfaced when they experienced difficulties with programs or concepts.

Whitley, Bernard E., Jr. "Gender Differences in Computer-Related Attitudes and Behavior: A Meta-Analysis." Computers in Human Behavior 13.1 (1997): 1-22.

Keywords: Research review, Experience, Attitudes and expectations, Age, Cross-cultural, Outside U.S., Stereotypes and bias

82 studies meeting selection criteria were included, covering 40,491 American and Canadian students from elementary grades, high school, college, and adults. ***Attitude findings****: Males, especially at the high school level, have accepted the stereotype of computers as a male domain more than women and girls. There were no gender differences in beliefs about the value of the computer. There were small gender differences in liking (medium at the high school level) and small-to medium differences in self-efficacy for the older three populations (none for elementary school children).* ***Behavior findings****. Gender differences were small for current behavior and prior experience, and did not vary significantly by age. Differences in prior experience did not mediate gender differences in attitudes.* ***Age group findings****. Effect sizes were largest for high school students, smallest for elementary school students; effect sizes for college students and adults fell between these extremes. Hypothesis to account for this: "[G]ender differences in attitudes toward computers result from socialization processes: the longer that children are in school, the greater the gender difference becomes. The decrease in mean effect size from high school to college populations may be due to self-selection: perhaps only young women with more positive attitudes, or young men with less positive attitudes, choose to go to college." (pp. 13-14)* ***Overall****. "[T]he smallness of the effect sizes indicates that any 'gender gap' that exists in computer-related attitudes and behavior .. is extremely small: gender accounts for about 1% of the variance in attitudes and about 2% of the variance in behavior." (p. 15)*

---. "Gender Differences in Computer-Related Attitudes: It Depends on What You Ask." Computers in Human Behavior 12.2 (1996): 275-89.

Keywords: Attitudes and expectations, Experience

Introductory psychology students were studied. There was a moderate gender difference for anxiety, a small difference for negative beliefs about the social impact of computers, and none for positive beliefs. Small to moderate differences were found on behavior measures (computer courses and time on computers). Although prior experience with computers did not mediate gender differences in anxiety, anxiety does appear to mediate gender differences in current computer-related behavior.

Whitley, Bernard E., Jr. "The Relationship of Psychological Type to Computer Aptitude, Attitudes, and Behavior." Computers in Human Behavior 12.3 (1996): 389-406.

Keywords: Attitudes and expectations, Experience, Learning styles, Postsecondary/tertiary

This was a study of 471 introductory psychology majors. ***Aptitude****. When SAT math scores were controlled for, there was no sex difference.* ***Attitude****. Women scored higher than men on computer anxiety and on negative beliefs about the effects of computers on society. There was no sex difference on positive beliefs.* ***Behavior****. Men had taken more college computer courses than women.* ***Conclusions****. Psychological type is more closely associated with computer-related behavior for women than for men. Women with a thinking preference reported spending more hours per week working on a computer than did women with a feeling preference or men with a thinking preference. Also, introverted intuitive women reported spending more recreational time on computers than did other women, statistically equal to men's level.*

Wilder, Gita, Diane Mackie, and Joel Cooper. "Gender and Computers: Two Surveys of Computer-Related Attitudes." Sex Roles: A Journal of Research 13.3/4 (1985): 215-28.

Keywords: Age, Attitudes and expectations, Programming, Experience

1) An entire school district in New Jersey, K-12, was surveyed. Children start school with a very slight tendency to see the computer as more masculine than feminine. The tendency shifts slightly from grade to grade, but it is more pronounced in elementary than high school. Both boys and girls report sharply declined liking after 6th grade. Differences are statistically significant but small. 2) All freshmen at a highly selective university were surveyed. There was no difference with previous experience, with the same exposure to computers in high school; both males and females had taken an average of one course. Males were somewhat more likely to have taken programming, though, while females were more likely to have taken a general introductory

*course. "Experienced females actually reported themselves to be less comfortable and no more skilled than unexperienced [*sic*] males." (p. 225), except if the females' experience had been in programming, in which case they rated themselves as more skilled than unexperienced males. So any previous experience with the computer increased comfort somewhat for both sexes, but only programming did so substantially for women.*

---. Gender, Computers, and Computer-Generated Games: Three Empirical Studies. Manuscript.

Keywords: Games, Experience, Attitudes and expectations, Single-sex environment

(1) A survey found that both male and female students K-12 viewed computers and video games as male activities. (2) A second survey found that among incoming university freshmen there was no significant sex different in experience but that females, including those with computer experience, rated themselves as less comfortable with computers than comparable males and no more skilled than inexperienced males. (3) Last, 4th and 5th graders played a computer-generated video game (either aggressive video game, non-aggressive video game, or nonaggressive pen-and-paper game) in randomly-assigned same-sex pairs, of which one was the player and one the observer. They were then observed playing with one of four toys of their choice. Girls, both players and observers, who played the aggressive video game were much more likely to choose the aggressive toy, up to boys' level (which was not affected by the type of video game), so the video games had much more effect on girls' free play than on boys'. Conclusion: "The behavioral consequences of similar experiences with technology may, in complex ways, be quite different for males and females." (p. 30)

Williams, S., and S. Rosenwasser. "Computer Interest Differences in Preschool Children According to Sex and Psychological Sex-Typing." Psychology and Human Development 2 (1987-88): 55-60.

Could not obtain: not reviewed.

Williams, Sue Winkle, and Shirley Matile Ogletree. "Preschool Children's Computer Interest and Competence: Effects of Sex and Gender Role." Early Childhood Research Quarterly 7 (1992): 135-43.

Keywords: Preschool, Attitudes and expectations, Age

82 preschool children were studied. Boys viewed the computer as masculine but girls viewed it as feminine. "Preschool-age females do not seem to have acquired the stereotype of the computer as 'masculine,'" as opposed to older girls.

Williams, Sue Winkle, Shirley M. Ogletree, William Woodburn, and Paul Raffeld. "Gender Roles, Computer Attitudes, and Dyadic Computer Interaction Performance in College Students." Sex Roles: A Journal of Research 29.7 (1993): 515 ff.

Keywords: Attitudes and expectations, Experience, Classroom interactions, Postsecondary/tertiary

In a study of college students' attitudes in relation to a computer task, past computer experience and masculinity were correlated for males with more positive computer attitudes. For females, only past computer experience correlated. Both male and female participants in the study asked more questions of male research assistants than of female research assistants.

Wilson, T. "Gender Equity and Computer Technology." Equity Coalition 5 (1999): 26-30.

Could not obtain: not reviewed.

Wolfe, Joanna, and Kara Poe Alexander. "The Computer Expert in Mixed-Gendered Collaborative Writing Groups." Journal of Business and Technical Communication In press (2005).

Keywords: Classroom interactions, Culture, Males, Single-sex environment

Mixed-sex teams of students in a scientific and technical writing class at a university were studied. A single male often emerged as the group computer expert. The computer work was highly visible, highly valued, and dominated by men. Writing, however, was less visible and selectively recognized; some men were credited with strong writing skills even when they did no writing. Some students explicitly leveraged their computer expertise to avoid writing. Computer experts rarely shared technical expertise with others in their teams.

Women and Minorities in Information Technology Forum. "Causes and Solutions for Increasing the Numbers in the Workforce Pipeline." Women and Minorities in Information Technology Forum. Old Dominion University, Hampton Virginia, 1999.

Keywords: Race, ethnicity, or SES, Retention, Career factors, Interventions

The conference summary examines reasons for under-representation by women and minorities in IT. Various intervention strategies, model projects, and research needs are presented in terms of factors affecting female and minority participation, recruitment and retention, and workforce preparation.

Women in Technology International. The Eniac Programmers. 1997. Available: http://www.witi.com/center/witimuseum/halloffame/1997/eniac.php, retrieved March 18, 2005. March 18, 2005.

Keywords: Programming

The first programmers, then called "computers," were 80 women at the University of Pennsylvania during World War II calculating ballistics trajectories.

Woodrow, Janice E.J. "The Development of Computer-Related Attitudes of Secondary Students." Journal of Educational Computing Research 11.4 (1994): 307-38.

Keywords: Attitudes and expectations, Experience, Parents and home, Outside U.S., Age

Students in British Columbia in grade 8 then grade 11(same students) were studied. Gender differences concerning computer attitudes diminished as students matured except in the case of gender equity attitudes: gender differences were minimal at grade 8 but very pronounced at grade 11. Gains in attitude were independent of gender, computer training, and computer course achievement. Confidence, liking, interest, acceptance and anxiety were all correlated with experience for both girls and boys. Computer attitudes were less positive for both boys and girls at grade 11 than at grade 8. Computer attitudes of boys were more sensitive to the influences of external factors such as experience, age, and computer training than was true of girls. The presence of a home computer did not influence computer attitudes for boys or girls.

Wright, R. "Women in Computing: A Cross-National Analysis." Women in Computing. Eds. R. Lander and A. Adam. Exeter, UK: Intellect Publishing Co., 1997. 72-83.

Could not obtain: not reviewed.

Wu, Yi-Kuo, and Michael Morgan. "Computer Use, Computer Attitudes, and Gender: Differential Implications of Micro and Mainframe Usage among College Students." Journal of Research on Computing in Education 22.2 (1989): 214-28.

Keywords: Attitudes and expectations, Postsecondary/tertiary

In a study of college students, there was no gender difference in attitudes toward computers among users of microcomputers and mainframe computers. The only gender difference was that females tended to be more concerned about the social impacts of computers, regardless of the type of computer used or the amount of computer use.

Yang, Chang-Kook. "Sociopsychiatric Characteristics of Adolescents Who Use Computers to Excess." Acta Psychiatrica Scandinavica 104 (2001): 217-22.

Keywords: Games, Use patterns, Outside U.S.

In a study of Korean adolescents, it was found that students who spent a great deal of time playing computer games or using chat rooms experienced a deterioration of social relationships, including isolation from friends, physical symptoms, drop in school performance, conflicts with family members, and decrease in sleep time. Male students tended to spend much more time on computers for these purposes than females.

Yeloushan, Kathleen. "Social Barriers Hindering Successful Entry of Females into Technology-Oriented Fields." Educational Technology 29.11 (1989): 44-46.

Keywords: Pipeline, Barriers, Role models and mentors, Attitudes and expectations, Experience, Mathematics, Career factors

Barriers to women's entry into technolgy occupations: attitudes, lack of role models, lack of or negative previous experience, association with math, lack of collaborative or social environment.

Young, Betty J. "Gender Differences in Student Attitude toward Computers." Journal of Research on Computing in Education 33.2 (1999): 204-16.

Keywords: Attitudes and expectations

In a survey of middle-school children, it was found that boys were more confident of their computer skills than girls despite teachers' encouragement of girls, girls' disbelief that computers are a male domain, and boys' belief that teachers did not take seriously their interest in technology careers.

Yuen, A., and W. Ma. "Gender Differences in Teacher Computer Acceptance." Journal of Technology and Teacher Education 10.3 (2002): 365-82.

Keywords: Teacher education, Attitudes and expectations, Outside U.S.

Pre-service teachers in Hong Kong were surveyed. Females' intention to use computers was influenced more strongly by perceived usefulness and perceived ease of use than was true of

males. For males, perceived ease of use influenced perceived usefulness more strongly than for females.

Zimitat, Craig. "Changing Student Use and Perceptions of Learning Technologies, 2002-2004." Australian Society for Computers in Learning in Tertiary Education. Perth, Australia, 2004.

Keywords: Use patterns, Outside U.S.

In an online survey of university students in Australia in their first year and again in their third, men used computers more than women for text messaging. Women read and wrote web logs more than men. There was no gender difference in use of discussion forums or accessing online information from work or home.

Zuga, Karen F. "Women's Ways of Knowing and Technology Education." Women's Leadership Symposium. Chicago, 1996.

Keywords: Culture, Policy

The culture of technology is prescriptive and depends upon compliance, leading to isolation, control, and the primacy of efficiency. Technology teachers need to implement a "social reconstruction curriculum" — an emphasis on the improvement of society a fundamental principle of curriculum selection and organization.