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Gender Differences in Computer-Related Attitudes and Behavior: A Meta-Analysis

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Abstract — *A meta-analysis of studies of gender differences in computer-related attitudes and behavior using US and Canadian participants found that men and boys exhibited greater sex-role stereotyping of computers, higher computer self-efficacy, and more positive affect about computers than did women and girls. These effect sizes varied as a function of study population — adult, college, high school, and grammar school — with the largest differences generally found for high school students. Gender differences in beliefs about computers approached zero and did not vary by study population. Gender differences in computer-related behaviors were small and did not differ as a function of study population. Implications of these findings are discussed. Copyright © 1997 Elsevier Science Ltd*

Computers pervade modern American society: offices automate, the home computer market expands, and home appliances that once were simply mechanical are now 'programmable'. These changes have led to an increase

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in what Card, Moran, and Newell (1983) refer to as 'human–computer interaction': any process in which "the user and computer engage in a communicative dialog whose purpose is the accomplishment of some task" (p. 4). The interaction of person and machine is affected by the characteristics of both the computer system and the person using it (Card et al., 1983; Schneiderman, 1980). One person-related variable that has captured the interest of both psychologists and computer educators is the gender of the computer user.

Computer use and skill at computer tasks have been portrayed in our society as more appropriate to men and boys than to women and girls. Today's college students and young adults have grown up in a social environment in which arcade computer games and educational software have been designed to appeal more to boys than to girls (Kiesler, Sproull, & Eccles, 1985) and computer use in schools has been linked to traditionally 'masculine' subjects such as science and mathematics but not to traditionally 'feminine' subjects such as art and literature (Hawkins, 1985). In addition, boys have been more likely to receive structured experiences with computers in school and in summer computer camps (Fetler, 1985; Hess & Miura, 1985). Finally, the mass media have portrayed computer use as a masculine domain (Ware & Stuck, 1985). Gender of the computer user could, therefore, be an important variable in human–computer interaction.

These gender differences in socialization have led to the hypotheses that women and girls are likely to hold more negative attitudes toward computers and to engage in fewer computer-related behaviors than are men and boys, resulting in a 'technological gender gap' (Canada & Brusca, 1993). Although considerable research has been conducted on these hypotheses (Kay, 1992; Rosen & Maguire, 1990), the results of that research, especially of research on gender differences in attitudes, has been mixed. For example, Kay (1992) described the results of this research as "conflicting and confusing" (p. 277) and Rosen and Maguire (1990) concluded on the basis of a meta-analysis that gender differences in attitudes were real, but small.

One possible reason for the apparent conflict and confusion in the attitude literature is that many researchers treat attitudes toward computers as a unitary construct rather than as a multifaceted construct. Multifaceted constructs are composed of two or more correlated components, each of which could have different relationships to another variable (Carver, 1989). The variety of computer attitude scales that have been developed and their differing content suggest that computer-related attitudes are indeed multifaceted, including components related to anxiety about using computers, self-confidence in dealing with computers, the acceptability of computers by professionals, positive and negative beliefs about computers and their effects on society, and computer-related behavior (LaLomia & Sidowski, 1991, 1993). If gender differences exist on some but not all of these components but the components are treated as equivalent, then the results of research would appear, as Kay (1992) noted, to be conflicting. In addition, averaging across relatively large differences on some components and small or nonexistent differences in other components in a meta-analysis would lead to a small mean effect size such as that found by Rosen and Maguire (1990).

The present research used meta-analysis to examine several questions concerning gender differences in computer-related attitudes and behavior. The first set of questions was "Do gender differences in computer-related attitudes exist?", "If so, how large are they?", and "Do they vary as a function of the attitude component assessed?" Answers to these questions were sought by assessing the magnitude of gender differences on two of the traditional components of attitudes, affective responses to computers and positive versus negative beliefs about computers (Eagly & Chaiken, 1993). In addition, gender differences in a third commonly measured aspect of computer attitudes, feelings of self-efficacy or self-confidence in using computers, were assessed. A second set of questions concerned computer-related behaviors: "Do men and women differ in their use of computers?" and "If so, how large is this difference?"

This research also examined data relevant to two hypotheses concerning the origin of gender differences in computer attitudes. First, as already noted, some researchers hypothesize that these differences stem from people being socialized to believe that computers are more appropriate to men and boys than to women and girls. Therefore, gender differences in the sex-role stereotyping of computers was examined. Second, some researchers hypothesize that gender differences in experience with computers lead to gender differences in computer-related attitudes (Maurer, 1994). Therefore, analyses were conducted to assess the strength of computer experience as a mediator of gender differences in computer-related attitudes.

METHOD

Meta-Analysis

Meta-analysis is a form of literature review that statistically combines the results of a set of studies (Cooper & Hedges, 1994). Thus, meta-analysis is a quantitative synthesis of the results of a set of studies that integrates the results of their statistical analyses, compared with the narrative literature review that uses qualitative techniques to integrate a body of research. In a meta-analysis, for each study the reviewer computes the size of the effect that the independent variable has on the dependent variable or, as in the present case, the size of the relationship between two variables. In either situation, this resultant variable is called the 'effect size' for the study. Effect sizes are standardized variables, so the reviewer can compute a mean effect size across studies without regard to the scale used to measure the variables in the studies. The reviewer can test the statistical significance of the mean effect size, and can group studies on the basis of common characteristics (such as age of participants) to determine if mean effect sizes vary as a function of the categories of the grouping variable. Similarly, the reviewer can compute the correlation between effect sizes and a continuous variable, such as the date of publication of the studies. (See Durlak and Lipsey, 1991, for a complete 'consumer's guide' to meta-analysis.)

Sample of Studies

Literature search strategy. Three methods were used to locate studies. First, computerized searches of the PsycLIT and Educational Resources Information Service (ERIC) databases were conducted from their inception through to the abstracts available in June 1994. Searches were conducted using the term 'comput* and attitud*', in which '*' is a wild-card character that institutes a search for any word having the designated stem. Second, the reference lists of prior literature reviews were examined for relevant sources. Finally, the reference lists of articles located by the other means were searched.

Criteria for including studies. The abstract of each study was examined and a study was selected for further inspection if it (a) had both male and female respondents to its attitude measures, (b) used respondents from the USA or Canada, and (c) collected original data. The second criterion was included to avoid potential extraneous variance in effect sizes resulting from cultural differences. Although the possible role of culture as a moderator of gender differences in computer-related attitudes and behaviors is of interest in its own right, it is outside the scope of this research. The last criterion was included because in some instances more than one study published by an author appeared to be based on the same data set. The studies that met these criteria were inspected to determine if an effect size could be calculated. If a study published in 1990 or later did not include the information needed to compute an effect size, I wrote to the person listed as the corresponding author to request the number of male and female respondents and their means and standard deviations on the relevant measures. Requests were sent out on 43 studies, 1 was returned as undeliverable. The authors of 4 studies could not supply the requested data, the authors of 10 studies supplied the data, and no reply was received from the authors of 28 studies.

Final sample of studies. These procedures resulted in a sample of 82 studies that provided 104 effect sizes based on 40,491 respondents (18,904 men and 21,587 women); these studies are listed in Appendix A. There were an additional 13 studies (listed in Table 5) that reported no sex difference and for which effect sizes could not be computed.

Measures of Attitudes and Behavior

Attitudes. Attitude measures were divided into the following five categories based on the descriptions of the measures given in the studies:

1. *Affect* measures assessed emotional responses to computers, including such constructs as anxiety, liking, and fear.
2. *Belief* measures assessed agreement or disagreement with positive and negative statements about computers and their perceived effects on people and society.
3. *Self-efficacy* or self-confidence measures assessed respondents' feelings of being able to competently operate or otherwise deal with computers.
4. *Mixed* content measures assessed more than one of the preceding types of attitudes and separate effect sizes could not be computed for each type.
5. *Sex-role stereotype* measures assessed beliefs about the degree to which computer use was perceived to be more appropriate to men and boys than to girls or women, or which assessed the degree to which men and boys were perceived to have more computer-related skills than women or girls.

Behavior. Measures of behavior were divided into two categories based on the descriptions of the measures given in the studies:

1. *Current behavior* measures assessed the amount of ongoing computer-related behavior reported by respondents, such as hours per week spent on a computer and enrollment in computer courses.
2. *Prior experience* measures assessed the amount of computer experience that respondents reported having prior to participating in the research, such as the number of high school computer courses taken by college students.

Coding the Studies

Each study was coded on three sets of characteristics. First, the type or types of attitude assessed, as already defined, were coded. Second, the respondent population of each study was coded into one of five categories: adults other than college students, college students, high school students, middle school students (Grades 6–8), and elementary school students (Grades 1–5). Studies that included members of more than one population and did not report results by population were placed in a sixth category. Of the 21 studies with adult participants, 6 did not specify the occupations of the participants, 5 used graduate students, 4 used teachers, 3 used managers, 1 used computer operators, 1 used patent examiners, and 1 used psychologists. Finally, a subset of studies described later was coded as to the year in which the data were collected. If a study did not report the year, it was coded as 2 years prior to publication of a journal article and 1 year prior to the presentation of a convention paper.

Statistical Analysis

Effect size. Except where noted otherwise, the difference between men's and women's means in standard deviation units (d), corrected for bias in estimating population effect size, was the effect size indicator. This statistic was calculated for each dependent variable using the DSTAT computer program (Johnson, 1989). In the results, a positive d indicates that men and boys reported more positive attitudes, held more sex-role stereotypic attitudes, and engaged in more computer-related behaviors than women and girls. When a study used multiple measures to assess one type of attitude or behavior, the effect sizes from each measure were combined using the procedures recommended by Rosenthal and Rubin (1986). Weighted mean effect sizes were computed using the formulas found in the chapter by Hedges (1994). Tables showing study populations, sample sizes, and effect sizes are available from the author.

Moderator variable analyses. The extent to which effect sizes varied as a function of study population and year of data collection was assessed using the procedures described by Hedges (1994). The Q statistic, which is distributed as chi-square, describes the extent to which a set of effect sizes is homogeneous. Lack of homogeneity between sets of effect sizes defined in terms of a moderator variable such as study population indicates that effect sizes vary as a function of that variable. For the study population analyses, a significant Q was followed up by making pairwise comparisons of mean effect sizes using Hedges' (1994) post hoc test.

Mediator variable analysis. The measure of effect size for the analysis of the mediating effect of prior experience with computers on gender differences in computer-related attitudes was the correlation coefficient (r). A positive correlation indicates that men held more positive attitudes toward computers, that men had more prior experience with computers, and that more experience was associated with more positive attitudes. For each study that reported all three correlations or provided information (such as an F value) from which a correlation could be estimated, the partial correlation (pr) between gender and attitude controlling for experience was calculated and the mediational hypothesis was tested by computing the weighted mean partial correlations (Hunter & Schmidt, 1990). A pr substantially smaller than the zero-order r would support the mediational hypothesis (Baron & Kenny, 1986).

RESULTS

Attitudes Toward Computers

The mean overall effect size averaging across the affect, beliefs, and self-efficacy components of attitudes toward computers was .232, $p < .001$, with a 95% confidence interval (CI) of .210–.254, $Q(96) = 335.60, p < .001$. The mean effect size was equivalent to a correlation of .12. Table 1 shows the mean effect sizes for population groups. Because preliminary analyses showed no difference in effect sizes on any variable for the middle school and elementary school groups, these groups were combined into a grammar school category. The mean effect sizes shown in Table 1 varied as a function of population, $Q(3) = 41.24, p < .001$. Post hoc comparisons indicated that the high school mean effect size was greater than that of any other group.

Because many studies assessed more than one component of attitudes toward computers, variations in effect size due to type of attitude measured could not be statistically assessed due to violation of the assumption that all effect sizes come from independent samples (Hedges, 1994). Therefore, separate analyses are presented for each component.

Affect. The mean affect effect size was .259, $r = .13$, $p < .001$, 95% CI = .233–.285, $Q(63) = 468.80, p < .001$. Table 2 shows the mean effect

Table 1. Mean Overall Attitude Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^{\dagger}$	Q	$k^{\ddagger}$
Adult	.180[a]*	.114–.247	.09	62.13*	20
College	.226[a]*	.192–.259	.11	108.25*	46
High School	.396[b]*	.341–.452	.19	83.70*	10
Grammar School	.161[a]*	.098–.224	.08	18.50	15

[a,b] Mean effect sizes having different superscripts differ at the .05 level of significance based on Hedges' post hoc test (Hedges, 1994).
† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
* $p < .001$.

sizes for the population groups. Mean effect sizes varied as a function of population, $Q(3) = 132.81$, $p < .001$. Post hoc tests showed that the high school mean effect size was greater than that of any other group and that the adult and college mean effect sizes were greater than the grammar school mean effect size.

Beliefs. The mean effect size for beliefs was .065, $r = .03$, $p = .001$, 95% CI = .026–.104, $Q(38) = 90.27$, $p < .001$. Table 3 shows the mean effect sizes for the population groups. Mean effect sizes did not vary as a function of population, $Q(3) = 5.47$, *ns*.

Self-efficacy. The mean effect size for self-efficacy was .406, $r = .20$, $p < .001$, 95% CI = .365–.446, $Q(30) = 277.13$, $p < .001$. Table 4 shows the mean effect sizes for the population groups. Mean effect sizes varied as a function of population, $Q(3) = 85.61$, $p < .001$. Post hoc tests showed that the high school mean effect size was greater than that for college and grammar school students, and that the adult and college student mean effect sizes were greater than that for grammar school students.

Have gender differences changed over time? This question was investigated by looking at the relationship between effect size (ranging from −.071 to .910) and year of data collection (ranging from 1984 to 1993) for the largest set of

Table 2. Mean Affect Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^\dagger$	Q	$k^\ddagger$
Adult	$.242^{a*}$	.152–.331	.12	31.77^*	11
College	$.220^{a*}$	.180–.259	.11	68.00^*	31
High School	$.611^{b*}$	.546–.676	.29	175.42^*	8
Grammar School	$.076^{c}$	−.010–.162	.04	32.36^*	10

a,b,c Mean effect sizes having different superscripts differ at the .05 level of significance based on Hedges' post hoc test (Hedges, 1994).
† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
$^* p < .001$.

Table 3. Mean Belief Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^\dagger$	Q	$k^\ddagger$
Adult	.088	−.046–.222	.04	13.28^*	7
College	.036	−.014–.086	.02	63.60^{***}	22
High School	.068	−.018–.154	.03	4.94	4
Grammar School	$.201^{**}$	.069–.332	.10	222.13^{***}	5

† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
$^* p < .05$; $^{**} p < .01$; $^{***} p < .001$.

Table 4. Mean Self-Efficacy Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^{\dagger}$	Q	$k^{\ddagger}$
Adult	.475[a,b]*	.331–.618	.23	4.79	3
College	.318[b]*	.255–.381	.16	41.83*	15
High School	.662[a]*	.590–.773	.31	127.24*	4
Grammar School	.091[c]	−.025–.207	.05	8.36	7

[a,b,c] Mean effect sizes having different superscripts differ at the .05 level of significance based on Hedges' post hoc test (Hedges, 1994).
† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
* $p < .001$.

studies that was reasonably homogeneous in population and attitude assessed, affect for college students and adults. The correlation between year and effect size was not statistically significant, $r = .10$. This finding is consistent with the results of longitudinal studies finding consistent gender differences over 3 year periods (Krendl & Broihier, 1992; Krendl, Broihier, & Fleetwood, 1989).

'No difference' studies. The studies reporting no gender differences in attitudes for which an effect size could not be computed are shown in Table 5. The table also shows the characteristics of the studies, including their levels of statistical power relative to the mean effect size for the attitude component assessed and the study population used. Only a few studies had a power level that approached Cohen's recommendation of .80 (Cohen, 1992). Consequently, many of the decisions that no gender differences existed may have been due to inadequate statistical power.

Sex-Role Stereotyping

The mean effect size for sex-role stereotyping was .539, $r = .26$, $p < .001$, 95% CI = .499–.579, $Q(18) = 436.21$, $p < .001$. Table 6 shows the mean effect sizes for the population groups; adults were not assessed in any study for which an effect size for that group could be computed. Mean effect sizes varied as a function of population group, $Q(2) = 65.62$, $p < .001$. Post hoc tests showed that the mean effect sizes for the high school and grammar school groups were greater than that for the college group.

Behavior

Current behavior. The mean effect size for current behavior was .326, $r = .16$, $p < .001$, 95% CI = .287–.364, $Q(17) = 107.27$, $p < .001$. Table 7 shows

Table 5. Power Analysis of Studies Reporting No Gender Difference in Attitudes

Study	*n* Male	*n* Female	Population[a]	Measure	Power
Arndt, Clevenger, & Meiskey (1985)	501	236	2	Mixed	.78
Campbell & Dobson (1987)	200	222	6	Affect	.57
Chen & Vechhio (1992)	88	29	2	Affect	.19
Clayborne & Seefeldt (1991)	596	624	4	Beliefs	.89
Gattiker, Gutek, & Berger (1988)	21	60	1	Beliefs	.14
Gutek & Bikson (1985)	235	282	1	Beliefs	.61
Martin, Heller, & Mahmoud (1992)	113	113	5	Mixed	.32
Norales (1987)	55	55	2	Affect	.18
O'Quin, Kinsey, & Beery (1987)	27	24	1	Mixed	.11
Pilotte & Gable (1990)	135	135	3	Affect	.99
Reid, Palmer, Whitlock, & Jones (1973)	105	109	2	Not Stated	.18
Smith (1986)	176	288	6	Efficacy	.98
Smith (1987)	35	97	1	Efficacy	.78
Smith (1987)	72	94	5	Efficacy	.25
Smith (1987)	32	43	4	Efficacy	.73
Smith (1987)	34	52	1	Efficacy	.64
Smith (1987)	87	87	5	Efficacy	.26
Smith (1987)	41	44	4	Efficacy	.15
Smith (1987)	33	35	3	Efficacy	.55

[a] 1 = adults; 2 = college students; 3 = high school students; 4 = middle school students (Grades 6–8); 5 = elementary school students (Grades 1–5); 6 = mixed populations.

Table 6. Mean Sex-Role Stereotyping Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^{\dagger}$	Q	$k^{\ddagger}$
College	.436[a]**	.294–.578	.21	10.67*	4
High School	.783[b]**	.720–.846	.36	226.62**	6
Grammar School	.665[b]**	.562–.767	.32	1.96	5

[a,b] Mean effect sizes having different superscripts differ at the .05 level of significance based on Hedges' post hoc test (Hedges, 1994).
† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
* $p < .05$; ** $p < .001$.

Table 7. Mean Current Behavior Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^{\dagger}$	Q	$k^{\ddagger}$
Adult	.238*	.075–.401	.12	24.71**	3
College	.404**	.333–.475	.20	28.27**	6
High School	.321**	.266–.377	.16	37.68**	4
Grammar School	.401**	.223–.579	.20	0.02	2

† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
* $p < .01$; ** $p < .001$.

Table 8. Mean Prior Experience Effect Sizes for Population Groups

Population	Mean Effect Size	95% Confidence Interval	$r^{\dagger}$	Q	$k^{\ddagger}$
Adult	.168**	.035–.301	.08	2.01	3
College	.232***	.170–.295	.12	22.55*	13
High School	.151**	.034–.268	.08		1

† Correlation corresponding to mean effect size.
‡ Number of effect sizes.
* $p < .05$; ** $p < .01$; *** $p < .001$.

the mean effect sizes for the population groups. Mean effect size did not vary as a function of population group, $Q(3) = 6.57$.

Prior experience. The mean effect size for prior experience was .208, $r = .10$, $p < .001$, 95% CI = .157–.259, $Q(16) = 26.39, p = .05$. Table 8 shows the mean effect sizes for the population groups; no studies assessed prior experience for grammar school students. Mean effect size did not vary as a function of population group, $Q(2) = 1.84$.

Prior Experience and Attitudes

Nine studies provided the data necessary to compute correlations among gender, prior experience, and attitudes (Arthur & Olson, 1991; Dambrot, Sillig, & Zook, 1988; Dambrot, Watkins-Malek, Sillig, Marshall, & Garver, 1985; Heinssen, Glass, & Knight, 1987; Ogletree & Williams, 1990; Perse, Burton, Kovner, Lears, & Sen, 1992; Stone, Kemmerer, & Gueutal, 1984; Temple & Lips, 1989; Woodrow, 1991). For these studies the mean correlation between gender and attitude was .114, $Z = 1.53$, *ns*, between gender and experience .150, $Z = 2.02, p = .04$, and between experience and attitude .218, $Z = 3.03$, $p = .002$. The mean partial correlation of gender and attitude controlling for experience was .080, $Z = 1.07$, *ns*. This small change in the correlation suggests that prior experience does not mediate gender differences in computer-related attitudes. However, given the small zero-order correlations, little mediation effect would be expected.

DISCUSSION

Table 9 summarizes the results of the meta-analysis, categorizing mean effect sizes as nonsignificant or as small, medium, or large using the criteria of Cohen (1992). As the table shows, the majority of the effects were nonsignificant or small, which is consistent with the results of Rosen and

Table 9. Summary of Mean Effect Sizes by Dependent Variable and Study Population

	Population			
Variable	Adult	College	High School	Grammar School
Attitudes				
Overall[a]	S	S	S	S
Affect	S	S	M	0
Beliefs	0	0	0	S
Self-Efficacy	M	S	M	0
Sex-Role Stereotyping	–	M	L	M
Behavior				
Current Behavior	S	S	S	M
Prior Experience	S	S	S	–

Note: Classification of effect sizes is based on Cohen's criteria (Cohen, 1992) applied to upper bound of 95% confidence interval: 0 = not statistically significant; S = small (.2 < *d* < .5); M = medium (.5 < *d* < .8); L = large (*d*>.8); – = no studies in this category.
[a] Combination of affect, belief, and self-efficacy.

Maguire's meta-analysis (Rosen & Maguire, 1990). However, mean effect sizes were found to vary as functions of attitude component and study population, which could have led to Kay's conclusions that the results of research in this area were conflicting and confusing (Kay, 1992). On the other hand, sex differences in computer-related behavior were, with one exception, consistently small.

Attitudes Toward Computers

Gender differences in attitudes clearly varied as a function of attitude component. The largest difference was for sex-role stereotyping, $d = .541$, followed by self-efficacy, $d = .406$, and affect, $d = .259$. Boys and men, compared with girls and women, saw computers are more appropriate to themselves, saw themselves as more competent on computer-related tasks, and reported more positive affect toward computers. Although the effect for gender differences in beliefs was statistically significant, it was functionally zero, $d = .065$.

Attitude component differences. The data on sex-role stereotypes suggest that men and boys have more readily accepted the societal stereotype of computers as a male domain than have women and girls. However, the meaning of this differential acceptance of the stereotype is unclear. Only a few studies have investigated the correlation between acceptance of these stereotypes and computer-related attitudes, and none have examined the relationship separately for male and female research participants. This separate examination is important because, as noted earlier, the sex-role hypothesis of gender differences in computer attitudes suggests an interaction between gender and stereotype acceptance as a cause of attitudes: there should be a positive relationship between stereotyped beliefs and computer-related attitudes for men and boys because they are socialized to believe that computers are more appropriate to them. Conversely, the hypothesis implies a negative relationship for women and girls: greater acceptance of the belief that computers are inappropriate to them should lead to less positive attitudes. In addition, the relationship between stereotype acceptance and attitudes might vary as a function of attitude component. Because the social stereotypes deals with gender differences in ability, acceptance of the stereotype might be more closely related to feelings of self-efficacy than to global affective responses or to beliefs about computers' positive and negative effects on society.

The mean of the essentially zero gender difference for beliefs is also unclear. Although it is tempting to take the finding at face value, a more complex situation might exist. Most scales assessing beliefs about computers are composed of both positive and negative statements, with the negative items being reverse-scored to produce a single attitude score rather than separate positive and negative attitude scores. However, factor analyses of computer attitude scales have found positive and negative beliefs to be relatively independent (Gardner, Discenza, & Dukes, 1993; Pilotte & Gable, 1990; Popovich, Hyde, Zakrajsek, & Blumer, 1987; Whitley, 1996a). In addition, Whitley (1996a, 1996b) has found that women score higher on negative beliefs than do men, but that there is no gender difference for positive beliefs. Combining across positive and negative items to form a single scale score could, therefore, dilute the gender difference for the negative items, especially if positive items outnumber negative items on the scale. Research on beliefs about the effects of computers must, therefore, address the positive and negative dimensions of the construct separately.

Study population differences. Effect sizes also varied as a function of study population, with the largest effect sizes generally found for high school students and the smallest for grammar school students, with effect sizes for college students and other adults falling between these extremes. These findings are consistent with those of Rosen and Maguire (1990), except that they had combined the grammar school and high school groups.

The increase in effect sizes from the grammar school to the high school populations is consistent with the hypothesis that gender 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 toward computers, or young men with less positive attitudes, choose to go to college. Selection may also account for the lower adult effect sizes, given that most of the adult samples were college-educated, consisting primarily of graduate students, teachers, and other professionals.

Alternatively, the difference in effect sizes found for the grammar school and high school populations could be a cohort effect. That is, perhaps changes in societal values and socialization processes in the schools have resulted in smaller gender differences in attitudes among today's younger children. If so, research conducted over the next decade should continue to show no gender differences in attitudes as today's grammar school children get older.

Computer-Related Behavior

Gender differences in computer-related behavior were generally small, in terms of both current behavior, d = .326, and prior experience with computers, d = .208. These effect sizes did not vary significantly as a function of study population. In addition, the results of the meta-analysis did not support the hypothesis that differences in prior experience with computers mediate gender differences in attitudes (Maurer, 1994). These results should not be taken as conclusive, however, because they are based on a relatively small number of studies that used a wide variety of operational definitions of both computer-related attitudes and prior experience with computers. Prior experience could be related to some types of computer attitudes, such as self-efficacy, but not to others, such as beliefs about the societal effects of computers. In addition, the studies reviewed defined prior experience in terms of quantity rather than quality; whether the experiences were perceived as being positive or negative may be more important than their number. Research more narrowly focused on specific types of attitudes and specific forms of experience and their affective valence may reveal a relationship.

Practical Significance of the Results

The gender differences found by the meta-analysis were statistically significant, albeit small. When the results of research are statistically significant but small, the question arises of their practical significance (Chow, 1988; Prentice & Miller, 1992); that is, are the effects found large enough to have practical importance? The answer to this question can be positive or negative when applied to gender differences in computer-related attitudes and behavior depending on the perspective that one takes.

On the one hand, as already noted, the variation in attitude effect sizes as a function of study population found in the meta-analysis is consistent with the socialization hypothesis of the development of computer-related attitudes. Consequently, the effect sizes found, although small, do serve the function of providing a test of the hypothesis (Chow, 1988). Similarly, the lack of variation in behavior effect sizes by study population suggests that the socialization hypothesis may apply to attitudes but not to behavior.

On the other hand, the smallness of the effect sizes also indicates that any 'gender gap' that exists in computer-related attitudes and behavior (Canada & Brusca, 1993) is extremely small: gender accounts for about 1% of the variance in attitudes and about 2% of the variance in behavior. In addition, although the gender gap is usually presented as a problem that needs to be resolved, the meaning of any such gap is, in actuality, ambiguous (McHugh, Koeske, & Frieze, 1986). For example, is the finding that, on average, women exhibit more negative computer-related affect, less computer-related self-efficacy, and less computer-related behavior than men necessarily bad? Lacking an objective standard for determining what constitutes the 'right' score, is it most accurate to conclude, for example, that women's lower average self-efficacy score means that (a) women have too little self-efficacy, (b) that men overvalue their abilities, or (c) that women and men having different self-evaluations, both of which fall within a 'normal' range? Data collected by Whitley (1996a) suggest that the latter explanation might be the best. He found that although men and women differed in their mean scores on several measures of computer-related attitudes, the average scores for both groups fell significantly above the midpoints of each of the scales. That is, both women and men had positive attitudes toward computers, although the average score for men was somewhat higher than that for women.

The more important questions concerning gender differences in computer-related attitudes and behavior come at the point where affect and self-efficacy become sufficiently negative that they significantly debilitate performance, such as when they result in total avoidance of computers. A 'technological gender gap' would truly exist only if women were overrepresented among people with debilitating computer attitudes or if the effectiveness of treatment approaches differed for women and men. Future research should probably focus more on these issues than on the simple documentation of attitudinal and behavioral differences between men and women.

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Wu, Y.-K., & Morgan, M. (1989). Computer use, computer attitudes, and gender: Differential implications of micro and mainframe usage among college students. *Journal of Research on Computing in Education, 22,* 214–228.

APPENDIX A: STUDIES INCLUDED IN THE META-ANALYSIS

Abler and Sedlacek (1987)
Arch and Cummins (1989)
Arthur and Olson (1991)
Badagliacco (1990)
Bandalos and Benson (1990)
Baylor (1985)
Bloom and Hautalouma (1990)
Braun, Goupil, Giroux, and Chagnon (1986)
Campbell (1988)
Campbell (1989)
Campbell (1990)
Campbell (1992)
Chen and Vechhio (1992)
Chen (1986)
Chu and Spires (1991)
Collis, Kass, and Kieren (1989)
Collis and Ollila (1986)
Dambrot, Sillig, and Zook (1988)
Dambrot, Watkins-Malek, Sillig, Marshall, and Garver (1985)
DeRemer (1989)
Dukes, Discenza, and Couger (1989)
Eastman and Krendl (1987)
Enochs (1984)
Farrell, Cuseo-Ott, and Fenerty (1988)
Flake (1991)
Gardner, Discenza, and Dukes (1993)

Gattiker, Gutek, and Berger (1988)
Gilroy and Desai (1986)
Gordon (1993)
Griffen, Gillis, and Brown (1986)
Gutek and Bikson (1985)
Harrington, McElroy, and Morrow (1990)
Heinssen, Glass, and Knight (1987)
Hudiburg (1990)
Hunt and Bohlin (1991)
Igbaria and Chakrabarti (1990)
Igbaria and Parasuraman (1989)
Igbaria and Parasuraman (1991)
Jacobson (1991)
Jagacinski, LeBold, and Salvedy (1988)
Kay (1989)
Kay (1993)
Kinzie, Delcourt, and Powers (1993)
Koohang (1986)
Koohang (1989)
Krendl, Broihier, and Fleetwood (1989)
Kwan, Trauth, and Dreihaus (1985)
Loyd and Gressard (1984)
Loyd and Gressard (1986)
Loyd, Loyd, and Gressard (1987)
Marcoulides (1991)
Marshall and Bannon (1986)
Massoud (1991)
Mathews and Wolf (1983)
Meier (1988)
Meier and Lambert (1991)
Miura (1987a)
Miura (1987b)
Morahan-Martin, Olinsky, and Schumacher (1992)
Morris (1988)
Mueller, Husband, Christou, and Sun (1991)
Murphy, Coover, and Owen (1989)
Nickell and Pinto (1986)
Ogletree and Williams (1990)
Omar (1992)
O'Quin, Kinsey, and Beery (1987)
Parish (1986)
Perse, Burton, Kovner, Lears, and Sen (1992)
Peters (1990)
Pope-Davis and Twing (1991)
Popovich, Hyde, Zakrajsek, and Blumer (1987)
Ray and Minch (1990)
Reid, Palmer, Whitlock, and Jones (1973)
Richards, Johnson, and Johnson (1986)
Riggs and Enochs (1993)
Rosen, Sears, and Weil (1993)
Shashaani (1993)
Smith (1987)
Stone, Kemmerer, and Gueutal (1984)
Swadener and Hannafin (1987)
Swadener and Jarrett (1986)
Temple and Lips (1989)
Vernon-Gerstenfeld (1989)
Vredenburg, Flett, Krames, and Pliner (1984)
Wagman (1983)
Weil, Rosen, and Wugalter (1990)
Whitfield and Bishop (1986)
Wilder, Mackie, and Cooper (1985)
Williams, Coulombe, and Lievrouw (1983)
Williams, Ogletree, Woodburn, and Raffeld (1993)
Woodrow (1991)
Wu and Morgan (1989)