Preface

This preface describes both the need for and purpose of this book—an interdisciplinary, meta-analysis of the larger systemic issues related to women's underrepresentation as developers, users, and beneficiaries of technology. This chapter explores: the data on computer and Internet access for users and beneficiaries of technology as well as data on women's participation in higher education and the professions; the need for interdisciplinary scholarship such as this; the problem with the "science wars"; the organization of this text; and the need for complex multidimensional solutions to the problem of women's participation in IT.

THE DIGITAL DIVIDE

The exponential growth of technology is fostering a concurrent growth in information, but it is digital information, which is primarily accessible only to those with certain privileges. Dale Spender (1995) describes how the growth of written information as a result of the mass dissemination of the printing press around 1450 parallels the contemporary growth of digital information as a result of computer technology. Both events inspired tremendous social revolutions on a large scale. In 1450, a series of dramatic social shifts occurred when individuals (who due to their social and economic status did not have access to books) suddenly had access to the world of ideas previously only available to the wealthy. Today's digital revolution has the same dramatic potential for social change, and "it is the change in society—the shifts in power, wealth, influence, organization, and the environmental consequences—that matters to us all as individuals, and as communities" (Spender, 1995, p. xiv).

The issue of power, of who holds the power, and of how they exercise that power, is one of the most significant issues we face as a global technology community. We live in a world with great disparities in social conditions. "The United Nations

Human Development Report 1998 reported that the world's 225 richest people have a combined wealth of over $1 trillion, or equal to the combined annual income of the poorest 2.5 billion people—47 percent of the world" (Eisler, 2002, p. 141). A similar gap exists in the United States where "the richest 1 percent's share of reported income" grew from 9.6 percent in 1979 to 17.5 percent in 2003, while "the bottom 40 percent's share fell from 11.3 percent to 8.8 percent" (Eisler, 2007, p. 202). Further, the "United States has the highest rate of childhood poverty among" industrialized nations with twelve million children living in poverty, which equates to "more than one in five children" (Eisler, 2007, p. 258).

In a global environment of such massive human inequality, what purpose should technology serve? How might we use technology to close the existing (and rapidly growing) gap between the haves and have-nots worldwide? How might we use IT in service of human need instead of placing humans in service of the technology? What are the most critical global social concerns that technology might serve? What if we focused "economic investments not just on technologies that yield short-term corporate profits but on those that yield long-term social and environmental profits"? (Eisler, 2007, p. 185) What kind of social revolution might our technologies create?

The explosion of technology, especially information technology, has brought us to another historic social crossroads—one where we must consider the answers to questions like these because this time our decisions will not just influence our small corner of the world, they will impact our global human community. The ways in which technology (and access to technology) influences our lives is up to us. *If* we ensure that all have access to technology (as developers, users, and beneficiaries of it), and *if* we consider the social impact of our technologies, then we have the potential to rapidly and profoundly reshape our human lives for the better.

Unfortunately, we suffer from a growing digital divide both within the U.S. and between the technologically-developed nations and others worldwide. I use the term "digital divide" broadly here to refer to power and access gaps in relation to users, beneficiaries, and developers of technology. First, let us explore who uses and benefits from technology in the U.S. The well-documented numbers are familiar to anyone who has studied this issue. In 2003, only 62% of U.S. households had a personal computer and 55% had Internet access; that still left nearly half of the U.S. population without Internet access in their homes ("Computer," 2005, p. 1). Several studies (one by the National Science Foundation and another by Federal Reserve Bank economists) continue to show how differences in race, family income, and educational attainment influence computer usage in the U.S. One study shows that while 72.9% of Asian families and 63.9% of Whites own home computers, only 44.6% of Black and 44.3% of Hispanic families do[1] ("Computer," 2005, p. 2). Among those who own home computers, fewer have Internet access at home:

Asians (66.7%), Whites (57.0%), Blacks (36.0%), and Hispanics (36.0) ("Computer," 2005, p. 2). Another study shows that "while 61.2% of whites and 62.7% of Asians use computers at home, only 35.7% of blacks and 31.6% of Hispanics do" (Valletta & MacDonald, 2003, p. 2). In their survey of K-12 students, DeBell and Chapman (2006) found that 64% of Whites and 63% of Asians use computers in their own homes, while only 43% of Hispanics, 35% of Blacks, and 27% of American Indians do (p. 27).

Family income is another powerful determinant of computer ownership and usage. One study shows that "2.7% of families with incomes under $15,000 own computers compared to 77.7% of families with incomes over $75,000; and [*sic*] among all families with incomes under $35,000 computer ownership of white families was three times that of African-American families and four times that of Hispanic families" (Kirk & Zander, 2004, p. 171). A 2003 study shows the dramatic influence of family income on home Internet access: under $25,000 (30.7%), $25,000-$49,999 (57.3%), $50,000-$74,999 (77.9%), $75,000-$99,999 (85.8%), and $100,000 or more (92.2%) ("Computer," 2005, p. 2). Another study shows that the "usage rate is 21.1% for individuals with family income under $15,000 per year and 79.6% for individuals with family income of at least $75,000 per year" (Valletta & MacDonald, 2003, p. 1). A more recent study in 2006 shows little change in these earlier data related to family income and percentage of home computer use: under $20,000 (19%), $20,000-$34,999 (32%), $35,000-$49,999 (45%), $50,000-$74,999 (54%), and $75,000 or more (66%) (DeBell & Chapman, 2006, p. 26).

DeBell and Chapman (2006) show that race and income differentially influence whether or not K-12 students used computers at all, not just in the home. While 93% of White students and 91% of Asian students in their study use computers, only 86% of Blacks and American Indians, and 85% of Hispanics do (p. 6). Fortunately, schools have some positive influence on bridging the computer use gap, but the degree of impact is also affected by family income. Following are the data that DeBell and Chapman (2006) report on family income and the percentage of students who used computers at all (which included school, home, and work): under $20,000 (85%), $20,000-$34,999 (87%), $35,000-$49,999 (93%), $50,000-$74,999 (93%), and $75,000 or more (95%) (p. 66). The advantages accorded by having a home computer vs. only the limited access provided by work or school are still strongly differentially correlated with race and income.

Some research suggests that educational attainment has a stronger influence on home computer use than family income, while other research shows family income to be a stronger predictor of home computer use. One study shows that "home computer use ranges from 18.9% for those with no high school degree to 81.9% for those holding graduate degrees" (Valletta & MacDonald, 2003, p. 1). DeBell and Chapman (2006) echo these findings in their discovery that parental

educational attainment directly and dramatically correlates with the percentage of K-12 students who use the Internet in their own home: less than high school (17%); high school credential (34%); some college (48%); bachelor's degree (56%); and graduate education (63%) (p. 26). U.S. Census data show a similarly strong correlation with educational attainment and home Internet access, but a slightly more powerful influence with regard to family income (cited in the previous paragraph): less than high school (20.2%); high school graduate/GED (43.1%); some college or associate's degree (62.6%); bachelor's degree (76.8%); and advanced degree (81.1%) ("Computer," 2005, p. 2).

Clearly, better access to education narrows the digital divide in relation to computer users, but who belongs to the exclusive club that actually develops the technology? Since IT is a professional field that increasingly requires formal academic training, one way to understand the demographics of those who develop technology is to look at the data on higher education. Table 1 lists data on the percentages of women and students of color who complete bachelor, master, and doctorate degrees in IT-related fields from two sources. The Taulbee Survey that is annually reported by the Computing Research Association (see www.cra.org) in *Computing Research News* shows the percentage of computer science and computer engineering degrees granted to women (Vesgo, 2007). The National Science Foundation report, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2007* (NSF 07-315), shows the percentage of women who receive engineering degrees as a percentage of all recipients, (see Table 1).

As this data evidence, while women degree recipients in computer science and engineering continue to make fairly steady progress, their numbers continue to grow slowly. They remain dramatically underrepresented in IT as compared to their numbers in the population as a whole. Another recent report shows:

That while the numbers of computer science majors at all levels of higher education has increased overall, there has also been a decline in the percentage of women and students of color at all levels. Of all computer science majors in the U.S., only 18.8% are women, 3.4% are African American, 3.6% are Hispanic, 21.7% are Asian/Pacific Islander (although this population is overrepresented, their percentage has still declined), and 0.4% are Native American. (Kirk & Zander, 2004, p. 169)

With this much inequity in a developed nation such as the U.S., how large is the digital divide on a global scale? Geographer Joni Seager (2003) reports that more "than 80% of Internet users are in the industrialized countries; Africa is the least wired" (p. 82). However, other data suggests that the numbers even in developed nations may not be as high. Balnaves, Donald, and Donald (2001) report the percentage of students who had access to the Internet from schools was 25% in France and

Table 1. Percentages of women who earned IT degrees

Year	Bachelor's (%)		Master's (%)		Doctorate (%)	
	Taulbee	NSF	Taulbee	NSF	Taulbee	NSF
1966		0.4		0.6		0.3
1967		0.5		0.6		0.3
1968		0.6		0.6		0.4
1969		0.8		0.7		0.3
1970		0.8		1.1		0.5
1971		0.8		1.1		0.5
1972		1.1		1.6		0.6
1973		1.2		1.7		1.4
1974		1.6		2.3		1.1
1975		2.1		2.5		1.7
1976		3.4		3.5		1.9
1977		4.9		4.4		2.8
1978		7.4		5.2		2.2
1979		9.1		6.1		2.5
1980		10.1		7.0		3.6
1981		11.1		8.1		3.9
1982		12.3		9.0		4.7
1983		13.1		9.3		4.5
1984		14.1		10.4		5.2
1985		14.5		10.7	11	6.3
1986		14.5		11.4	13	6.7
1987		15.3		12.6	10	6.5
1988		15.4		12.4	9	6.8
1989		15.2		13.0	13	8.3
1990		15.4		13.6	13	8.5
1991		15.5		14.0	12	9.0
1992		15.6		14.7	11	9.3
1993		15.9		14.8	14	9.2
1994	18	16.5	19	15.4	16	10.9
1995	18	17.3	20	16.2	16	11.6
1996	17	17.9	20	17.1	12	12.3
1997	17	18.4	23	18.1	14	12.3
1998	17	18.6	23	19.8	14	13.1

Table 1. (continued)

Year	Bachelor's (%)		Master's (%)		Doctorate (%)	
	Taulbee	NSF	Taulbee	NSF	Taulbee	NSF
1999	17	NA	26	NA	15	14.8
2000	19	20.5	26	20.7	15	15.7
2001	19	20.1	27	21.2	16	16.9
2002	18	20.9	25	21.2	18	17.5
2003	18	20.3	26	20.8	17	17.0
2004	17	20.5	25	21.1	18	17.6
2005	15	20.0	25	22.3	15	18.3
2006	14		23		18	

Germany, 28% in Italy and Japan, 59% in the U.K. and the U.S., 63% in Taiwan, 74% in Canada, and 78% in Sweden (p. 17).

Those who claim that access gaps are closing often point to public libraries as a solution. However, a few comparative numbers make clear that there is widely varying access to public libraries globally. In 1999, the number of people per public library was 6,000 per library in Germany, 11,000 per library in the U.K., 23,000 per library in France, 35,000 per library in Japan, 52,902 per library in Kenya, 337,000 per library in Egypt, and 1.5 million per library in Nigeria (Balnaves et al., 2001, p. 17). Language remains another barrier to Internet access today with English dominating the Internet, "although other languages, such as Spanish and Chinese, are expected to be equally widespread by 2020" (Balanves et al., 2001, p. 16). Further, since the vast majority of current Internet content is in English, we must ask exactly what members of other cultures have access to? The World Wide Web in its current manifestation has the potential to be a significant tool for spreading a new kind of cultural colonialism, diluting local values and beliefs in favor of those that reflect English-speaking industrialized cultures. Finally, all of these statistics on access assume a literate population. However, about "20 percent of the world's population and about 30 percent of women are illiterate" (Balnaves et al., 2001, p. 16). Given the deep-rooted causes of some of these barriers, how can we begin to increase the number of those who are developers, users, and beneficiaries of technology?

BRIDGING THE DISCIPLINARY DIVIDE

One important first step towards bridging the digital divide is to close the disciplinary gap between the social sciences (e.g., women's studies, ethnic studies, psychology, and sociology) and the "hard" sciences (e.g., math, engineering, and computer sci-

ence); these two discourses rarely intersect, either theoretically or practically. In fact, traditional education is so narrowly focused on a single-discipline approach that ideas are often "taught as if they had nothing to do with each other—and often as if they had nothing to do with real life" (Eisler, 2002, p. 3). Given the rigid disciplinary boundaries within which most academic publishing occurs, scholars tend to write about their area of expertise for other experts in their field. Therefore, IT professionals tend to write about technology for technologists, and social scientists tend to write about social science for their colleagues.

There is little academic discourse that bridges these disciplinary gaps. This is the primary reason that although many scholars have recognized that there is a problem regarding the participation of women in IT, few have an adequate understanding of the complexities of the problem and its origins. Due to the narrow definition of disciplines and the emphasis on expertness, most educators, scholars, and administrators in education are only familiar with the discourse of their field of expertise. Feminist science studies scholars and other social scientists have spent decades researching and identifying the deep-rooted and systemic causes for the paucity of women and people of color in science and technology. However, their work is little known to those who are in the position to effect the greatest change, that is, IT scholars, educators, and administrators.

Existing books by women's studies and social science professionals tend to focus more deeply on the details of these systemic social influences, leaving out a broader overview of how these systems function that could be easily understood by anyone other than scholars in the field. Two books that attempt to offer broader overviews of feminism for a general audience are Allan G. Johnson's (1997) *The Gender Knot: Unraveling Our Patriarchal Legacy* and bell hooks'[2] (2000) *Feminism is for Everybody: Passionate Politics*. However, neither of these books explores how these issues manifest themselves in specific relation to science and technology.

In a 2002 paper, computer science educator Carol Zander and I first attempted to bridge the disciplinary gap and issued the following "call to action" to computer science educators:

Our task is also to bridge the intellectual divide between those who 'do' science and women's studies . . . When all of us better understand the challenges we face in recreating a more inclusive learning environment, we can collaborate towards even richer solutions together. (p. 123)

Two years later, we attempted to further narrow the disciplinary divide by reviewing two new books in the context of the question, "Which book might be most valuable to a computer science educator in higher education who is seeking a map to mend the gap created by the digital divide?" (Kirk & Zander, 2004, p. 169). *Unlocking the Clubhouse: Women and Computing*, written by a computer scientist

and a social scientist, had already received a great deal of recognition among IT professionals. However, *Gender and Computers: Understanding the Digital Divide* (2003), written by social psychologists Joel Cooper and Kimberlee D. Weaver, was little known in the computer science community. Although the first book provides a good overview of the problem and proposes some solutions, the second book provides evidence of the deeper and often less well-understood influences of gender, race, and socioeconomic factors in terms of the negative impact of stereotyping, especially on the psychology of learning. Understanding the deeply-embedded nature of these problems and the ways in which they are woven into the fabric of all of our social institutions is critical to the creation of viable and lasting solutions.

This book proposes to further bridge the disciplinary divide by providing a "primer" on feminist science studies for IT scholars, educators, administrators, and all those who are interested in a deeper understanding of the large-scale, systemic, historical influences that have contributed to the dearth of women and people of color in IT today. I offer one feminist scholar's perspective on the root causes of women's poor representation as developers, users, and beneficiaries of technology. If computer scientists better understood the work of social scientists, they would not need to devote their energies exclusively to conducting research to further document a problem that is well-understood, but could also spend some energy in being creative change agents. Rushing to "solve" the problem using single-cause solutions, without a richer knowledge of the more complex, multifaceted social causes, will only ever lead us to partially successful results (if they are successful at all). I also propose a few strategies for addressing the problem from a variety of standpoints. However, my hope is that when equipped with a more thorough understanding of the problem's causes, we can all work together to devise even better, more complex solutions than those I propose here.

While most research focuses on documenting the details of a specific problem, often without any context at all, this book engages in an interdisciplinary, meta-analysis—engaging the results of many studies from diverse perspectives—in an attempt to help readers understand the issues in a broader social context and on a systems level. Mohanty, Russo, and Torres (1991) explain the value of interdisciplinary feminist scholarship that engages in "context-specific differentiated analysis"; feminist analysis must be context-specific by beginning with a *thorough* understanding of the context from which a social situation arises, and it must be differentiated by including issues and perspectives from multiple traditional disciplines, such as history, politics, and social science (p. 67). Eisler's (1987, 2000, 2002) systems science approach—"that analyzes how different parts of a system relate to each other and to the larger whole"—is central to the creative frame employed in the construction of this book (p. 3). Eisler (2007) describes our current social system as predominantly a "dominator" model (one based primarily on control) and offers suggestions for how we might move towards a "partnership" model (based primarily on respect); this text

honors the concept of partnership by inviting readers to participate in knowledge creation with me, not merely to passively receive the information recorded on these pages (p. 5). My hope is that this broader interdisciplinary, systems-level perspective will help readers begin to participate in envisioning solutions—to inspire a multiplicity of voices and minds to start where they are to create change rather than wait for further expert scholarship to narrowly define the problem.

At its core, authentic feminist scholarship is about reorganizing hierarchical systems of power-over. However, like all human endeavors, this work is subject to the foibles of individual humans and their differing understandings of, or ideas about how to manifest, this new world vision. Therefore, this book is simply one attempt to describe the possibilities that I see in a new vision that places power in the hands of individuals rather than social institutions. The perspectives that I engage are just "a mapping of a terrain that has interested me and some others—not the mapping of it" (Harding, 1998, p. x). I do not pretend to present "THE" truth about these issues. I present the truth as I have come to know it, based on my social standpoint, and based on my scholarly expertise. As Harding (1998) wisely expressed, "truth claims all too often have the effect of closing down conversations, of asserting arrival at a final account" (p. x). My desire is to keep the conversation open, and I hope that readers will consider this the beginning of a dialogue "between peoples who rarely have occupied the same institutional locations" (Harding, 1998, p. x).

NEGOTIATING A CEASE FIRE IN THE "SCIENCE WARS"

In order to engage in a meaningful dialogue across what may be very different perspectives, it seems important to negotiate a cease fire with regard to the so-called "science wars."[3] Feminist scholars have spent decades asking and answering questions about how our social systems function, and feminist science scholars have focused on these questions in specific relation to science and technology. Unfortunately, feminism has become the new "F" word for many and as such feminist "perspectives are often charged with being biased, because they are overtly political" (Spanier, 2001, p. 370). However, this charge ignores the irrefutable fact that all knowledge creation is socially situated while many of those in the sciences worship the "cult of objectivity" which allows them to deny "social, cultural, and economic influences" on the production of scientific knowledge (Spanier, 2001, p. 370). To claim that scientific and technical knowledge is created in a social context that has some influence on that creation is tantamount to saying "the emperor has no clothes," which accounts (at least, in part) for the "outsider" status of feminist thought in relation to science. These issues are focused upon in detail in Chapter II in an exploration of dualisms and stereotypes.

The "science wars" are an example of how difficult it can be to even ask questions about how we think about and/or "do" science and technology; this is sacred territory and to challenge it risks accusations of scholarly sacrilege. However, this particular debate culminated in the publication of *Higher Superstition: The Academic Left and Its Quarrels with Science* (1994) by life scientist Paul Gross and mathematician Norman Levitt. Gross and Levitt sharply critiqued the work of social scientists exploring questions in science studies as inherently unscientific. Others chimed in on this debate. Many "hard" scientists supported Gross and Levitt while social scientists did not. In 1995, the New York Academy of Science sponsored a conference titled "The Flight from Science and Reason," inferring that social scientists were guilty of having "lost their sense" (Kleinman, 2000, p. 2).

In *Higher Superstition: The Academic Left and Its Quarrels with Science*, Gross and Levitt (1994) devote a chapter titled "Auspicating Gender" to critiquing the so-called "feminist attack" on science (p. 108). According to Gross and Levitt, sexist discrimination "is largely vestigial in the universities" and the only "*obvious* discrimination today is against white males" (p. 110). The authors also claim that women's studies and feminist criticism has "sacrosanct status" in the academy that provides "unprecedented immunity to the scrutiny and skepticism that are standard for other fields of inquiry" (p.110). This is most certainly not the case at my university where our women's studies program does not even have department status, is served by faculty housed in other "real" departments, and where it took me 4 years to get my course titled Women in Math, Science and Technology (the focus of my doctoral studies) through the curriculum approval process to meet a general education category in social science. My course proposal was exposed to a level of scrutiny far beyond that of other courses in more traditional disciplines. Feminists at universities nationwide are struggling with similar pressures and challenges to their credibility as scholars. In fact, there has been growing dialog at the National Women's Studies Association annual conferences in the past few years about how to help the discipline thrive in an environment of heightened "backlash" against the field. (See www.nwsa.org for more information.)

As further evidence of the favored status of women and the discrimination against white males, Gross and Levitt (1994) cite the increased numbers of women in certain areas of science, with a cursory acknowledgement of the low numbers of women in some areas; they cite no data to support this claim of increased female enrollment. They also cite the fact that job searches at universities have requirements in place to include women in their pool of candidates, but cite no data on the underrepresentation of women who actually occupy these faculty positions. The persistent disparity in women faculty salaries in relation to men is not examined in the text at all.

In 2004, the American Association of University Professors (AAUP) reported the following for women faculty positions in all areas: 58% (instructors), 54% (lecturers),

46% (assistant professors), 38% (associate professors), and 23% (full professors) (Curtis, n.d.). The ratio of women's salaries to men's in the same positions are less and these "ratios have changed very little over twenty-five years in the AAUP data" (Curtis, n.d.). In 2004, the AAUP reported the percentage of women's earnings in relation to men's in the same positions were: 96% (instructor), 90% (lecturer), 93% (assistant and associate professor), and 88% (full professor) (Curtis, n.d.). These data show that women occupy lower status and less permanent positions in higher numbers. The numbers of women in faculty positions in computer science and engineering follow a similar pattern with regard to rank and are much lower than women in other fields. The latest Taulbee Survey conducted by the Computing Research Association, reports that the share of women faculty in computer science and computer engineering has grown between 1990 and 2007, but women remain seriously underrepresented in these areas. In 1990 women were: 9% (assistant professors), 8% (associate professors), and 3% (full professors). In 2007 women were: 20% (newly hired tenure-track), 19% (assistant professors), 13% (associate professors) and 10% (full professors) (Vesgo, 2007, p. 2-3). However, Vesgo (2007) also notes that the National Science Foundation reported even lower data for women faculty during the same period in computer science and engineering: 14% (assistant professors), 13% (associate professors) and 8% (full professors) (p. 3).

Gross and Levitt (1994) also object to mathematical word problems with diverse subjects that try to avoid race, gender, and cultural stereotyping, but make no mention of the extensive literature from social psychology on the documented relationship between "stereotype threat" and academic performance. For example, they might have attempted to critique the extensive social psychology literature explored in Cooper and Weaver's *Gender and Computers: Understanding the Digital Divide* (2003). Gross and Levitt also object to questioning the use of sexist language and metaphor, but make no mention of a whole literature on how language as a social institution reifies beliefs and attitudes of all kinds. For example, for their argument to have weight, they would need to counter the extensive arguments made by scholars such as Evelyn Fox Keller (1985, 1992, 2002) and Dale Spender (1980, 1995) in multiple books and essays.

In making their case against feminism, especially feminist science studies, Gross and Levitt (1994) lump together diverse thinkers from a broad array of academic disciplines into a group they call "humanists and social scientists" and then redub "the academic left." With regard to questions and critiques of natural science, Gross and Levitt (1994) then accuse their self-defined "academic left" of "muddleheaded-ness," of not expressing a "self-consistent body of doctrine," of professing a variety of different doctrines "with no well-defined center," and "the absence of a central body of doctrine that can be said to constitute the quintessence of that view" (pp. 1-10). The problem with this approach is their method itself; if you define the ter-

rain broadly enough, you might make a similar critique of any body of knowledge. For example, if I lumped together distinct disciplines such as applied mathematics, mechanical engineering, and nuclear medicine and labeled them "the academic right," I might make a similar critique that they have no central doctrine.

Gross and Levitt (1994) attempt to further support their claim by saying that these "misconceived attacks on science . . . grow out of a doctrinaire political position" (p. 9). The implicit message is that science as these authors do it has no such political position. However, the historical fact of research-funding alone weakens this position, even if you do not believe in seriously considering the ways in which the political, social, economic context in which scientific and technical knowledge is created may influence its creation.

Gross and Levitt (1994) also attempt to argue that recent critiques of natural science from the "academic left" stem from a "resentment" of science (p. 12). The authors claim that this resentment emanates from several sources: (1) a kind of scholarly envy of the hierarchical value placed on the sciences that makes social scientists want to "regain the high ground, to assert that the methods of social theory and literary analysis are equal in epistemic power to those of science" (p. 12); (2) "a lingering distrust of science and technology . . . [deriving] from the long tradition of fear and loathing toward the nuclear arsenals of the world"; and (3) "the misgivings of the environmental movement toward technology" (Gross & Levitt, 1994, p. 27-33). However, Gross and Levitt (1994) clearly have a political position (and seemingly deep-seated resentment) of their own. For example, how can a scholarly text, which claims to value scientific "objectivity," use a term like "fire-breathing feminist zealots" with implicit reference to respected scholars such as Sandra Harding and Evelyn Fox Keller, who they have explicitly included in their "academic left"? (p. 37). At the end of this same passage, they say, "Nor is this book in any sense an update of the *Malleus Maleficarum*; we shan't give our readers detailed instructions for finding the witch's mark" (Gross & Levitt, 1994, p. 37). Associating Harding and Keller with a medieval handbook for persecuting and burning "witches" does little to further dialogue. In the end, Gross' and Levitt's own biases are revealed in this passage:

If . . . the humanities department of MIT (a bastion, by the way, of left-wing rectitude) were to walk out in a huff, the scientific faculty could . . . patch together a humanities curriculum, to be taught by the scientists themselves . . . What the opposite situation—a walkout by the scientists—would produce . . . we leave to the reader's imagination. (p. 243)

I return to the accusation that Gross and Levitt make of the "academic left," that they are resentful of science and want to get back at scientists for the years

of academic elitism that garners scientists more respect for their scholarship than social scientists. The passage above seems to suggest that it is Gross and Levitt who resent the voices of the "academic left" that are being heard in the discussion of science studies.

Gross and Levitt (1994) argue that only scientists are entitled to serve as *social* critics of science, and their key objection to others doing this work seems to be that "common to all of them is a failure to grapple seriously with the detailed content of the scientific ideas they propose to contest" (p. 235). They accuse their self-defined "academic left" of not bothering to "know science," but feeling entitled to critique it (p. 6). First, I might make the same accusation of these two authors; one is a life scientist and the other a mathematician. Using their own argument, I could claim that they are unqualified to critique a huge body of scholarship from a variety of disciplines that they admit themselves not to be expert in—the social sciences. There is a contradiction here. The authors simultaneously argue for the sanctity of disciplinary expertise, while they engage in an extensive critique of disciplines in which they are not expert. Further, their argument is simply inaccurate; most of the authors whose examples they critique are in fact scientists or mathematicians who do engage in a close critique of science. For example, Evelyn Fox Keller's academic training was in physics through to the doctoral level. However, lastly, and most importantly to this author, their argument misses the point that there is great value in interdisciplinary research and interdisciplinary dialogue. Perhaps if we could respectfully dialogue across the rigid confines of traditional disciplinary boundaries, we might have developed an even richer knowledge tradition by now. I believe that it is the perceived threats to the sanctity of the knowledge tradition itself that is at the core of Gross' and Levitt's concerns.

As Daniel Lee Kleinman points out in *Science, Technology and Democracy* (2000), it seems odd that this debate only arose in the mid-90s when the scholarship in science studies that first explored the social construction of knowledge was published in the 70s and 80s. Kleinman (2000) suggests that the debate arose partly due to significant changes in public policy that restructured research funding practices and heightened the competition for resources. After World War II and during the Cold War years, most funding was based on a "social contract with science" in which the government allowed scientists autonomy and control over their research if they would focus their research on "improvements in national social and economic well-being" (p. 3). As Kleinman (2000) reasons, several things have changed since then: (1) the Cold War is over and there is no longer a need to fund research that promotes "a vibrant democracy in contrast to the totalitarian world of our Soviet adversaries"; and (2) the promise of science's social contract has become a mixed blessing in the eyes of the public with some scientific research saving lives by curing human diseases while other research results in technologies that threaten lives

by contributing to disasters such as Love Canal and Three Mile Island (pp. 3-4). Kleinman suggests that the primary reason that the science wars debate occurred was an "effort to reinforce a crumbling boundary: a wall that divided scientists and lay citizens, a barrier that legitimated scientists' autonomy on expert matters and dictated citizen silence" (p. 5). However, especially in a democracy, one question is at least worth asking: Why can't average citizens be involved in public policy with regard to science and technology that will impact their lives?

Although I endorse Gross and Levitt's right to disagree, the so-called "science wars" are a manifestation of the very climate (in which such unsubstantiated claims against feminist scholars can easily gain a large voice) that we need to better understand and address if we are ever to create a more inclusive science and technology. This "us v. them" attitude is ironically a pointer to the very problem itself. The fact remains that as of January 14, 2005, we still lived in a society where Harvard University President Dr. Lawrence Summers found it appropriate to build a case that women's underrepresentation in science and technology is primarily due to "issues of intrinsic aptitude" and that "socialization and continuing discrimination" are lesser factors (Bombardieri, 2005). Summers was speaking to a select group of 50 elite scholars attending an invitation-only conference titled "Diversifying the Science and Engineering Workforce" sponsored by the National Bureau of Economic Research (Bombardieri, 2005). Summers' remarks instigated a walk-out by some of the notable women in attendance, such as then chancellor designate (later chancellor) of the University of California, Santa Cruz Dr. Denise Denton[4], who held a B.S., M.S., and Ph.D. in electrical engineering from MIT and was the first woman in the U.S. to serve as Dean of a College of Engineering at an NRC-designated Research One university (She served 9 years as Dean at the University of Washington) ("Chancellor," 2006).

What makes these remarks even more difficult to comprehend is that Summers' scholarship is in economics, but he felt free to use "evidence" such as observing his own twin daughters to justify his argument that differences in aptitude are the primary reason why there is a shortage of women in science and engineering, ignoring the contradictory evidence of scholars who study these issues. Meanwhile, the percentage of tenured job offers made to women in Harvard's College of Arts and Sciences declined during his tenure; in 2004, only 4 of 32 tenured job offers went to women. To be fair, Summers denounced this as "unacceptable and promised to work on the problem." He also subsequently apologized for his comments at the conference, but this did not stop the Harvard faculty from passing a vote of no confidence in his leadership a few months later (Bombardieri, 2005). Unfortunately, Summers' sense of entitlement to comment on the causes of the problem without an adequate understanding is not uncommon, and it is one of the primary reasons that we all need a better understanding of the complexity of these issues if we are ever to create lasting change.

ORGANIZATION OF THIS BOOK

This book uses a feminist perspective to place what we know so far about the under-representation of women as developers, users, and beneficiaries of IT (from early education through to the workforce) in the context of the larger social institutions that influence our lives, and describes how shifting from a dominator to a partnership social system can make a difference in who participates in IT. Each chapter begins with a list of objectives that identify the broader understanding that readers should gain from that chapter and ends with a list of "Questions for Reflective Dialog." Rather than providing a summary, my hope is that these questions will inspire readers to reflect in dialog with others, enabling them to co-create knowledge in relation to the ideas I have shared in this book.

The book is organized in three sections. Section I: One Feminist's Perspective (Chapters I through III) lays the foundation for understanding the perspective that informs this book by exploring the ways in which the fundamental elements of a dominator social model undergird all of our social institutions, especially how they influence women's participation as developers, users, and beneficiaries of technology.

Chapter I: "Demyth-ifying Feminism: Reclaiming the 'F' Word" explores how and why feminism became a "dirty" word and offers my perspective on the feminist project. I also describe why I believe that feminism offers a useful perspective from which to examine power relations in terms of both individual identity and the beliefs and attitudes purveyed by social institutions. To further clarify the meaning of feminism, I explore the following six myths about feminism and the social system that we have created: (1) it's just the way things are; (2) it's just about women being equal to men; (3) men and women are just different by nature; (4) feminists want to be like men; (5) I don't have a race, I'm White; and (6) it's "their" problem, not mine.

Chapter II: "Dualisms and Stereotypes: Tools of Domination" explores the concept of gender as the ultimate dualism, and demonstrates the pervasive ways in which stereotypes are used as tools of domination in dominator societies. Dualistic thinking encourages us to organize knowledge in simplistic "either/or" terms, rather than considering the "both/and" complexities of our real human experience. Understanding gender, the ultimate socially-defined dualism, can help one begin to grasp the deeply-embedded nature of gendered attitudes and beliefs in the social institutions through which we learn about IT. The stereotypes (of gender, race, class, physical ability, etc.) that are purveyed by our social institutions are some of the most enduring and significant influences on our sense of individual identity as well as how we perceive (and are perceived by) others in the social hierarchy. An in-depth understanding of stereotypes, especially gender stereotypes, is critical to

beginning to understand how to address the participation of women in IT as developers, users, and beneficiaries.

Chapter III: "Gendered Philosophy of Science: Science is Male, Nature is Female" lays the last few bricks of the foundation for this book by examining the gender dualism (science=male, nature=female) that is at the core of the philosophy of science and influences the ways in which we have learned to think about science, as well as the attitudes and beliefs about who can (or should) participate in science and IT.

Section II: Perspectives on Dominator Social Institutions (Chapters IV through VII) examines how four social institutions—media, language, education, and business—teach the values, attitudes, and beliefs of a dominator society in specific relation to IT. Each chapter begins with a few general themes representative of that social institution and then provides an in-depth example of how these themes are reflected in specific relation to science and IT.

Chapter IV: "Mass Media as Social Institution: The *Wired* Example" explores the role of mass media as a primary social institution that teaches us about ourselves and our world. In the U.S., and in the global IT field, media play an increasingly powerful role in terms of interpreting our world, and that interpretation also makes heavy use of stereotypes to convey a message. This chapter offers a few general examples of the ways in which this influences women's participation in IT as well as a more in-depth analysis of one form of mass media—the widely-read computing magazine, *Wired*. *Wired* offers an interesting ground for analysis of the influence of stereotypes in mass media since one of its founding purposes was to discuss technology in relation to culture.

Chapter V: "Language as Social Institution: The Male-Centered IT Culture" offers an analysis of the role of communication and language as another social institution that teaches us the values, attitudes, and beliefs of our culture and that uses stereotypes pervasively. I explore these issues by discussing why "political correctness" matters, our gendered communication style, the male-centered IT language and culture, and the influence of dominance, violence, and sex metaphors in IT on women's participation.

Chapter VI: "Education as Social Institution: Understanding Her-Story" explores the ways in which education as a social institution teaches us values, attitudes, and beliefs. Education plays a particularly key role since it is the social institution that defines the knowledge tradition itself—the bounds around what is known, what it is important to know, and who knows. This chapter offers a brief her-story of women in math, engineering, and IT, as well as describing trends in education and employment.

Chapter VII: "Business as Social Institution: Global Issues in IT" explores ways in which the global IT business operates as another significant social institution

purveying attitudes, values, and beliefs that contribute to the underrepresentation of women as beneficiaries, users, and developers of technology. This chapter analyzes the following major issues: (1) the values reflected in the global IT business model; (2) the relationship between postcolonialism and U.S. participation in global economic development; and (3) the rising social and political significance of economic development in India and China with specific relation to the IT industry. As a way of asking questions about what values the global IT industry might be concerned about, we look through the lens of an in-depth example—IBM's global business relationships and the Holocaust.

Section III: Perspectives on Partnership Social Institutions (Chapters VIII through XI) offers ideas and examples for how we might develop and teach the values, attitudes, and beliefs of a partnership social model in specific relation to IT. These chapters offer examples in relation to the same four social institutions explored earlier: media, language, education, and business. I have separated a deeper exploration of the problem from suggestions for "solutions" for several reasons. One reason, and perhaps the most important one, is that I wanted to offer readers the opportunity to begin to envision their own solutions as we explore the problem more deeply together. Another reason is that although my suggestions emanate from my expert perspective on the available research in this area, they are not the only correct answers. My hope is that by allowing readers to begin to frame their own solutions as they read, my solutions will be viewed as less prescriptive and more as new perspectives from which to think about how to develop more complex, systemic solutions together.

Chapter VIII: "Partnership Language and Media: Creating a New IT Culture" offers ideas for how we might shift away from a dominator social model to a partnership model in relation to language and media. This chapter explores the following ideas for how we can co-create the conditions that encourage partnership language and media: (1) identifying core components of a partnership culture that are particularly relevant to language and media; (2) developing partnership language and communication by understanding the cultural components of voice and silence, focusing on linkages in relationships in IT, practicing dialogic process, and practicing nonviolent communication; and (3) offering an example of new partnership media—*connect!* magazine.

Chapter IX: "Partnership Science and Technology Education" explores strategies for redefining education as a social institution. This chapter explores the following suggestions for shifting education (especially science and IT education) towards a partnership model by: (1) exploring partnership ways of knowing; (2) considering the needs and perspectives of users and beneficiaries of science and IT in education; (3) educating teachers from kindergarten through college to better understand how our current system works as well as how to co-create partnership; (4) redefining

student-teacher relationships in terms of partnership; (5) co-creating collaborative learning environments; (6) developing partnerships systems of testing, evaluating, and measuring learning; and (7) offering examples of partnership curricula and programs.

Chapter X: "Partnership Global IT Business" introduces a partnership economic model and attempts to envision answers to questions about our social responsibility to each other as a human community with regard to the direction of development efforts in the global IT industry. For example: How might we use technology to close the existing (and rapidly growing) gap between the haves and have-nots worldwide? What are the most critical global social concerns that technology might serve? To address some of these questions, this chapter explores the following topics in relation to co-creating a partnership global IT business: (1) U.S. economic dominance in IT; (2) "partnerism" a new economic model; (3) global IT development ideas between developed and developing nations; (4) partnership IT policy making; and (5) examples of partnership science and IT.

Chapter XI: "A Concluding Pledge: With Technology and Justice for All" recaps the main themes of this book and offers suggestions for (1) future research, and (2) where you can begin to co-create partnership and provides an epilogue from the author that demonstrates the ways in which social change is a lifelong learning experience.

Appendix: Recommended Resources offers a few resources for readers to educate themselves further about the issues raised in this book. This is not meant to be a comprehensive list, but offers a good starting point for further reading. As I suggested earlier, the work of understanding an issue whose roots are as deeply-embedded in our social structures as this one requires a long-term commitment. The readings are grouped in the following sections, which loosely relate to the structure of this book: feminism and partnership, feminist science studies (I have included a few things here, such as Cohoon and Aspray, that are not explicitly feminist, but are doing nonetheless important work to understand the problem of women's participation in IT), media studies, language and communication, education, her-story, global economics and partnership science, films, and organizations working toward change.

FINDING OUR COMMON GROUND WHILE CREATING COMPLEX SOLUTIONS

We cannot seek unidimensional solutions to such a multidimensional problem as the underrepresentation of women as developers, users, and beneficiaries of technology. There is no one-size-fits-all solution to the problem of increasing the participation of women in IT. We need complex multifaceted solutions for a complex multifaceted

set of problems. And, it will take all of us, technologists and social scientists, educators and business leaders, women and men, working together to create the kind of change that will really make a difference in women's lives and in our world. In order for all of us to participate in envisioning and enacting more comprehensive, more complex, and more responsive solutions, we need a richer understanding of the problems in their complexities.

When addressing issues that are labeled as social concerns, some believe that it is enough to attend a diversity workshop or read a book or two about gender, race, and class. However, that is unlikely to lead one to the kind of deep understanding that is required to participate in constructive change on a larger scale. Understanding how systems of power and privilege work in our society is a real challenge because the nature of these systems is to teach those who are privileged by them to be blind to the ways in which they are privileged. With a limited understanding, which is all that many of us have, organizational change efforts can be too simplistic or too short lived. Johnson (2006) describes the problem:

Most organizations' failure in the area of diversity occurs not because they're run by mean-spirited bigots—few are—but because they deal with issues of privilege badly or not at all, unless a crisis forces the issue. Even then, they deal with it only enough to make it seem to go away, which usually doesn't include confronting the reality of privilege and oppression. (p. 65)

In their comprehensive edited collection *Women and Information Technology: Research on Underrepresentation* (2006), J. McGrath Cohoon and William Aspray explore the latest research on women in IT from early education through higher education to the workforce. Cohoon and Aspray support the point I am making here when they suggest that "[w]ell-intentioned interventions, based on the best intuition of pioneering activists, have not been able to reverse the downward trends, perhaps because more nuanced strategies based on the complexities of the situation were needed" (p. ix). The authors add that two things contribute to the continued underrepresentation of women in IT: (1) "inadequate understanding of the underlying and immediate causes" and (2) "inadequate intervention efforts" (p. 137).

Addressing the underrepresentation of women in IT is about helping more of those who are in positions of power to understand how deeply and tightly these problems are woven into the fabric of our society. It is a large-scale project that requires a long-term commitment by a group of well-informed change agents who are committed to ripping up the deeply buried roots of systemic oppression. Unfortunately, adopting a traditional scientific view may lead some to delay action because they believe that we do not understand the relationship between gender and participation in IT well-enough. I believe that social scientists do understand the relationship between

gender and participation in IT very well, and that we simply need to talk and work across the disciplinary divide. In fact, regarding concerns such as the underrepresentation of women in IT, I would like to see us move away from an "either/or" argument altogether. We might be better served by adopting a "both/and" perspective; those who choose to continue to further document the problem in increasingly detailed levels of specificity can (and should) continue to do that kind of research, *and* those who feel that the problem is well-understood can begin to commit their energy to finding better, more creative, and more complex solutions to solving it. We can do both. Fortunately, there has been a recent shift away from research that simply seeks to understand the problem to more complex research efforts that seek to solve the problem. Cohoon and Aspray (2006) cite new NSF programs such as "the ITWF, the new Broadening Participation in Computing, and Gender Science and Engineering" as well as organizations such as the National Center for Women in IT, the Anita Borg Institute, and many others (p. 471).

Feminism has long supported the notion of linking theory and action, of not separating what we know from applying that knowledge to change our world. This is one reason that a feminist perspective may be particularly useful in addressing the underrepresentation of women as developers, users, and beneficiaries of IT. Interestingly, although they only mention feminism (or feminist perspectives) on a few pages of their nearly 500-page book, Cohoon and Aspray seem to share my perspective that it is time to act:

We cannot afford to wait to act until we have a perfect understanding of the issues; we are wasting too many resources by having so few women involved in computing—a waste for their own careers and for the nation as a whole. We can learn while we act . . . (p. 473)

In *Our Endangered Values: America's Moral Crisis* (2005), former U.S. President and Nobel Peace Prize winner Jimmy Carter said, "It is in America's best interests to understand one another and to find as much common ground as possible" (p. 5). This is as good a place as any to begin this book, because in the end, this is a story about finding our common ground and about cultivating a new society from that rich fertile soil. This is not another story about the so-called "battle of the sexes"—a violent metaphor which in itself reflects the dominator social system that we are all caught up in. This is not another story about "us" vs. "them." This is a story about the ways in which we are all one "us."

This is a story about using feminist perspectives to find common ground where we can better understand the ways in which the social system that we have co-created is not serving us. This is a story about how to shift from a dominator to a partnership society. This is a story about building a democratic society for the citizens of this globe. This is a story about how IT could play a major role in such

a constructive social shift. As Spender (1995) explains, the digital revolution is creating a tremendous social shift, but the direction of that shift will be defined by those who participate in it. We are at a crossroads as a human species, and the road that we take will be determined both by the limits of what we already know and by our capacity to imagine the world we have yet to create. This book is my attempt to help us envision that new world in relation to IT, to help us envision moving beyond the simple notion of access to the richer notion of co-creating global partnership.

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ENDNOTES

[1]   I have included the only four racial/ethnic categories (White, Black, Asian, and Hispanic) included in this study. Native Americans and biracial data were not gathered.

[2]   Gloria Watkins chose not to capitalize her pseudonym "bell hooks" in order to give primacy to the ideas over the author.

[3]   The description of this debate as a "war" is a classic example of how themes of dominance and violence pervade our society as well as science and technology. I will discuss these issues further in subsequent chapters.

[4]   I met Denise Denton briefly when she participated in a conference that I organized on women in computing at the University of Washington, Bothell campus while I was teaching in the Computing and Software Systems program. She was personable, kind, and humble in a way that struck me as particularly remarkable given her history of exceptional achievement. Sadly, Dr. Denton took her own life on June 24, 2006 after serving 16 months as Chancellor of the University of California, Santa Cruz (UCSC). Certainly, there are many factors (most of which are mysterious to those of us who are still here) that might cause one to commit suicide. However, as a feminist science studies scholar, I know too much not to at least wonder whether the lifelong weight of the forces I explore in this book on her courageous soul had finally become too much to bear. If people only knew what carrying this burden really costs women, even great women.

[5]   Some portions of this chapter may have appeared in, and are reprinted with permission from Kirk, M. (2006). Bridging the digital divide: A feminist perspective on the project. In G. Trajkovski (Ed.), *Diversity in Information Technology Education: Issues and Controversies* (pp. 38-67). Hershey, PA: Information Science Publishing.

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