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**In a Different Format:
Connecting women, computers and education using Gilligan's framework**

Joan Carmichael

**A Thesis
in
The Department
of
Educational Studies**

**Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada**

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ABSTRACT

In a Different Format:
Connecting women, computers and education using Gilligan's framework

Joan Carmichael

Women are not equal participants and do not have equal power in the hierarchally organised industrial workplace and they will not automatically become equal partners in the new information workplace that is based on computers. Equal access to computer education for males and females has not empowered women for several reasons. Educational barriers and attitudes as well as different learning styles may affect the way women learn. This thesis examines the ways in which women have had unequal access to science and technology, and subsequently, computers. It adopts the conceptual framework articulated by Carol Gilligan - one based on caring, responsibility to the individual, networking and cooperation - and integrates it through education *about* computers and education *using* computers to show how both women and work could benefit from a new approach to computer education.



In a Different Format:

Connecting women, computers and education using Gilligan's framework



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Chapter I

Statement of the Problem

Women are not equal participants and do not have equal power in the hierarchally organised industrial workplace, nor will they automatically become equal partners in the new information workplace that is based on computers. In order to strengthen the position of women, I propose the adoption of the conceptual framework described by Carol Gilligan as the paradigm for the new workplace - one based primarily on caring, responsibility, networking and cooperation - and integrating it through education *about* computers and education *using* computers into the workplace. This would offer solutions to two problems at the same time: it would give a new and needed operational structure to the information workplace that would benefit all workers; it would also give recognition and validity to women's values, thereby enhancing women's position and esteem in society and in the marketplace. There would be two beneficiaries, women and work.

Overview

This thesis outlines Carol Gilligan's framework and suggests how it could be applied in an educational setting to further women's learning about and with computers. It is built on the assumption that women are not equal partners in the workplace and the reason for this is that women lack power. It examines this lack of power and inequity by first looking at the origins of modern science, then technology and education up to the present day to see whether certain factors are causing the problems. Finally, it proposes a different educational pedagogy based on Gilligan's model to effect change. It is intended to be an inclusive model but it is one that begins with women. While there are questions as to whether this paradigm is *the* answer or even one of the answers, research into the direction that the workplace is evolving has turned up a surprising trend.

Chapter II examines Gilligan's conceptual framework developed mainly, but not exclusively in her book, *In a Different Voice* (1982). At no point is this framework meant to be a comparison to another paradigm, educational or not, as this implies that one is better than the other. A main object of this exercise, as in Gilligan's framework, is to avoid the dichotomies that produce winners and losers. This chapter looks at Lawrence Kohlberg's moral 'justice' framework which was Carol Gilligan's starting point, then reflects on her findings of a 'care' perspective that parallels his: at the conflicting images and the problems of language of this different perspective. It analyzes the origins of the 'care' perspective and includes an appendix of studies done by others using her framework.

Chapter III moves back to analyze the origins and practice of modern science. It outlines four women scientists and their work as illustrations of four different problems women have faced in working in science. Then it looks at the male bias in science and various issues such as connections between women and nature that have been made to see if this is where the problems lie. It reflects on women of science who have accepted and worked within the present science paradigm and those who have a new vision of science and call for change.

Chapter IV examines technology as separated from science as a discipline. It looks at the development of technology in general, then computer technology in particular. It examines how computers are used in the workplace now and some future applications or directions that can be seen from here. It contemplates the philosophy of computers and why they are seen as 'toys for boys'. Then it questions the present vision of science and technology and calls for women to develop a critical understanding of the new computer technology.

Chapter V moves to an examination of education and the problems females have had and continue to have within the school system in relation to education in general and computer education in particular. This chapter then deals with values and attitudes as barriers and enhancers. It analyzes how mathematics has been used as a barrier and as a 'critical filter' that discriminates against women. It looks at other negative female attitudes that could present problems to computer learning and some positive ones that could enhance learning. Then it questions whether education is the only solution to women's empowerment and, if not, from what other directions

change could come and how this could be implemented.

Chapter VI takes into consideration Gilligan's framework of chapter II and the findings on science, technology and education in chapters III, IV and V to propose a new educational paradigm for introducing computers to women. It attempts to answer why we should teach women about computers, which women we are addressing, and what we mean by computer literacy.

Next it analyzes what is meant by 'learning styles' as a determinant to constructing a women's pedagogy of computer education. It examines the effect of teaching styles, how to move through the barrier of silence in women, peer teaching and self-learning. It looks at the effects of the physical computer environment, how to de-mystify the computer, the underlying philosophy of the software and how to integrate women's interests. It questions how to effectively change the present paradigm and some problems with this new paradigm as reflections for future research. Finally, it closes with a view of the direction in which the workplace of today is heading and what this means in terms of connecting it with women, computers and education.

Chapter II

Carol Gilligan's Conceptual Framework

Introduction

This chapter will examine Carol Gilligan's conceptual framework of a Care Ethic and show how it fits into, rather than contrasts with, Lawrence Kohlberg's Ethic of Rights and Justice. It will also explain why Gilligan claims that this is an ethic or focus which is identified more by 'theme' than by gender. The different concepts that are illustrated by this framework become the basis for the construction of a 'different format', a different way of seeing, which will be used to develop a pedagogy of computer education for women as well as the framework for viewing the science/technology/computers continuum.

Lawrence Kohlberg

Carol Gilligan developed her Care Ethic framework when she saw problems with the moral framework as set down by Lawrence Kohlberg. To understand her framework we have to first examine Kohlberg's vision of morality. Gilligan describes Kohlberg's moral framework as an extension of the early work of Piaget. Kohlberg

“discovered six stages of moral judgement, which he claimed formed an invariant sequence, each successive stage representing a more adequate construction of the moral problem, which in turn provides the basis for a more just resolution.” (Gilligan,1982:10, 1977:483)

If we look at Kohlberg's six stages as hierarchal steps that move from one level to another, with Stage 1 as the lowest and Stage 6 as the highest, they are:

Stage 1 a person is moral because he fears punishment or desires approval from others,

Stage 2 a person's morality is based on behaviour that will satisfy the self,

Stage 3 a person tries to gain approval by helping others,

Stage 4 a person defers to patterns of authority and convention, he does his duty to win respect,

Stage 5 a person's morality is based on principles/rules,

Stage 6 universal principles of fairness, human rights, justice are the basis for personal morality.

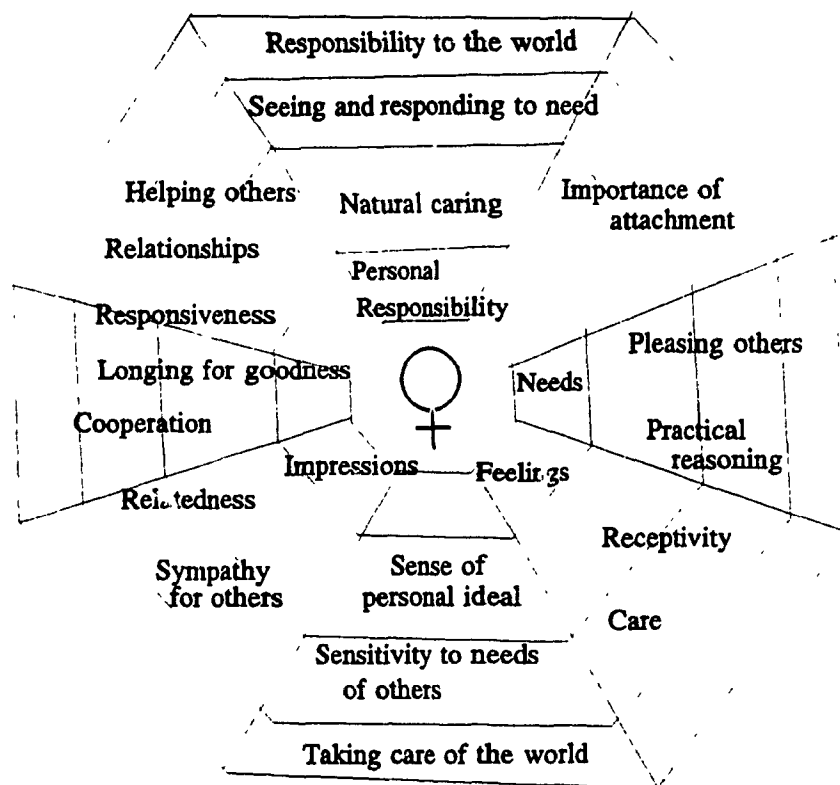
Each level denotes a significant expansion of the moral point of view from an egocentric through a societal to a universal ethical conception. (Kohlberg, 1976:34,35)

Looking at Stage 3 - where a person tries to gain approval by helping others we see the stage where Kohlberg located women's morality for the most part. This is the societal or conventional judgement level which is based on the shared norms and values that sustain relationships, groups, communities and societies. (Gilligan,1982:73)

Gilligan's framework

Carol Gilligan outlines a different perspective, one which centres on this Stage

3. It is a moral framework that is an ethic of caring and a network or web where all the concepts are connected.¹



1

Ethic of Care

In the centre of this web, I envision feelings, impressions and needs and these concepts connect to the interrelated ones of care, attachment, relationships, cooperation, etc. They move out from here to a responsibility to the world and taking care of the world. It is a circular network of connectivity and interrelatedness. The concepts are not separated hierarchally as I see Kohlberg's concepts but are free to move and join with one another.

Gilligan describes this morality:

This conception of morality as concerned with the activity of care centres moral development around the understanding of responsibility and relationships, just as the conception of morality as fairness ties moral development to the understanding of human rights and rules. (Gilligan,1982:19)

She sees this ethic as more concerned with the web of relatedness than the hierarchy of rules - a morality not of rights but of recognizing connection and taking responsibility for it. Responsibility to others comes first and is an "extension of action not a limitation of action"; this is an ethic of attachment and intimacy, not an ethic of autonomy and achievement. It is attachment supported by an ethic of care, not separation justified by an ethic of rights.

It is an ethic based on cooperation, not competition. To illustrate male competitiveness as contrasted with female play, Gilligan examines studies that show that boys learn primarily through games, in which rules dominate and girls learn primarily through play which has no winners or losers and in which rules may be changed or thrown out. For boys, the end of the game is victory which automatically requires a loser; for girls, the end of play is experience.

She sees this different construction of the moral problem by women as the main reason for their failure to develop within the constraints of Kohlberg's system. Kohlberg defines the highest stages of moral development as deriving from a reflective understanding of human rights. This morality of rights and justice differs from the morality of responsibility and caring in its emphasis on separation rather than on connection, in its consideration of the individual rather than the relationship as primary. (Gilligan,1982:19)

For women then, moral problems arise from conflicting responsibilities rather than from competing rights. The moral *weakness* of women shows itself as a confusion and diffusion of judgement which cannot be separated from its moral *strength* which is a prevailing concern with relationships and responsibilities. This concern for others leads to a reluctance to judge others and this leads to women's psychology being seen as problematic and difficult to understand. (Gilligan, 1982:16,17)

The reason that women's experience has been so difficult to understand or even distinguish is that shifting the imagery of relationships contributes to the problem of its interpretation. The images of hierarchy and web convey different ways of structuring relationships and are associated with different views of morality and self. But these images create a problem in understanding because each distorts the other's representation. At the top of the hierarchy, one view, usually male, is that of the ultimate goal and, as well, the fear that others may get too close while the other view, usually female, is that of being stranded and being too far out on the edge. While being in the centre of the web defines safety and the centre of connection for some, it might mean an uncomfortable closeness for others. These are unlike fears - being stranded and being caught and give rise to different methods of action and different ways of assessing the consequences of choice.

These are paradoxical truths of human experience, that we know ourselves as separate only insofar as we live in connection with others, and that we experience relationship only insofar as we differentiate other from self. (Gilligan, 1982:62,63)

Gilligan sees that one part of the problem may be rooted in the different languages that men and women speak that they assume are the same. They use

similar words to describe dissimilar experiences of self and social relationships. Because these languages share an overlapping moral vocabulary, they contain a tendency for mistranslation, creating misunderstandings which obstruct communication and limit the potential for cooperation and care in relationships. (Gilligan, 1982:173)

She suggests that we have to not only listen to one another but to hear and understand what each one says. While each has different modes of experience, they are, in the end, connected.

While an ethic of justice proceeds from the premise of equality - that everyone should be treated the same - an ethic of care rests on the premise of non-violence - that no one should be hurt. This dialogue between fairness and care not only provides a better understanding of relations between the sexes but also gives rise to a more comprehensive portrayal of adult work and family relationships. The recognition that there is another way to look at a problem may expand moral understanding. (Gilligan, 1982:236)

She looks for a cooperative integration of male and female values which could lead to a changed understanding of human development and a more generative view of human life. (Gilligan, 1982:173)

While the two very different frameworks of Gilligan and Kohlberg seem to point to a *male* framework as opposed to a *female* one, Gilligan explains that she called her book *In a Different Voice*, not *In a Woman's Voice*, because she does not claim that an ethic of caring rests only with women but only that it is a different perspective perceived more often by females than males. "The *different voice* is characterized not by gender but theme...[and] no claims are made about the origins of these voices or their distribution in a wider population, across cultures, or time."

(Gilligan,1982:2) Thus, she states that the care perspective is neither biologically determined nor unique to women.

It is, however, a moral perspective different from that currently embedded in psychological theories and measures and it is a perspective that was defined by listening to both women and men describe their own experience. (Kerber et al,1986:327)

A study on Justice and Care perspectives: more than one model

Following from this idea of *theme*, in a study done with Jane Attanucci, Gilligan and Attanucci (1988a) examine evidence of what they call *Justice* and *Care* Perspectives or Focus in forty six men's and thirty four women's discussions of actual moral conflicts. They also consider whether an association between moral orientation and gender exists. They found that concerns about justice and care are both represented in people's thinking about moral dilemmas but individuals tend to focus on just one orientation and minimize the other. Care Focus dilemmas are more likely to be presented by women and Justice Focus dilemmas by men and the recognition that there is another way to look at a problem could expand our moral understanding.

Also, they feel that if women are excluded from a study of moral reasoning, the Care Focus could easily be overlooked. (Gilligan,1988a:232) Choosing all male research samples, as Kohlberg and others did before him, leads us to believe that men in the context of Western culture may have difficulty noticing the omission of women or seeing this omission as significant, and, as well, women may experience difficulty in noticing or seeing the omission of themselves, or in judging that omission to be non-trivial. (Gilligan, 1988a:454)

In another similar study, Nona Lyons (1983) presents interview data from female and male children, adolescents, and adults in support of the thought of having two distinct modes of describing the self in relation to others - separate/objective and connected, as well as two kinds of considerations used by individuals in making moral decisions, those of justice and care.

She proposes that theories of cognitive and social development should recognize that individuals construct, resolve, and evaluate problems in distinctly different ways. These differences are not simply in content, but seem to be related to two different perspectives toward others. Therefore, theories of cognitive and social development built on single models of social perspectives should be reconsidered.

So too, counsellors, teachers, and managers, when dealing with conflicts within relationships, need to take into account that the language of morality in everyday speech has different meanings for people, as Gilligan points out earlier, and that these may carry behavioral implications. For example, what people feel obliged to do or what their responsibilities to others are may be defined and understood differently.

People characterizing themselves as autonomous or separate in their relations to others more frequently use considerations of justice and fairness in their moral decision making; people describing themselves as interdependent or connected in their relations to others more frequently use considerations of response of care. In connecting these ideas of self, morality and epistemology, Belenky and others, expand on what Carol Gilligan first suggested - that is, that there is a connection between

people's ideas of self and their ideas about morality.(Lyons,1983:141, 1987:227,8)

That Gilligan's framework is viable and can be applied as a moral theory is shown by some researchers in moral development and moral reasoning who have used Gilligan's framework alone or in combination with that of other moral theorists such as Piaget, Kohlberg, and Eriksson. Others have taken and applied this framework to the different fields of counselling, social work, student services, moral education and day care. (See Appendix A for a bibliography of research done by others using Gilligan's framework.)

Carol Gilligan has been criticized and called on to defend this framework. However, this thesis rests on accepting her framework as given as it is not meant to be a comparative analysis of the merits of the care perspective over the justice perspective. I am not proposing Gilligan's framework as the 'best' or even a 'better-than' one because such constructions are hierarchal but as an alternate voice, used to construct a different educational 'format' for teaching women about computers - an area where women have been shown to be unequal participants both in the schools and in the workplace.²

² **Gilligan's critics and her replies**

Jyotsna Vasudev (1988:239-244) in criticizing the Gilligan and Attanucci study (1988a) maintains that sex differences disappear in studies that control for socioeconomic status and she presents a demand for theory-driven research to substantiate Gilligan's theory. Gilligan and Attanucci (1988b:451-456) argue against this claim. They contend that women and men are not socioeconomic equals and recommend that theories based on all-male research samples be questioned and that differences in women's moral orientation be accounted for in studies.

Lawrence J. Walker (1984) examined issues arising from Kohlberg's theory of moral reasoning and Gilligan's theory of moral orientation. He found consistency between response to hypothetical and real-life dilemmas supporting the position that stages are holistic structures. But he also found that few individuals showed consistent use of a single moral orientation and that the relation between sex and orientation was inconsistent. His findings led him to conclude that Kohlberg's theory and

(continued...)

²(...continued)

scoring system fail to support the notion that they are biased against the 'female' response orientation. (Walker, 1984:667-9)

Catherine G. Greeno and Eleanor E. Maccoby (1986) use the Walker study to criticize Gilligan by claiming that Walker found no trend whatever for males to score at higher levels than females on Kohlberg's scales. They call for Gilligan to demonstrate a quantitative difference in the proportion of the two sexes who show different perspectives. In the same paper, Zella Luria refers to the Walker study to emphasize that the data do not support any finding of a statistically significant sex difference. (Kerber et al, 1986:312-318)

Gilligan replies to Greeno, Maccoby and Luria's criticisms based on the Walker article by claiming that her critics completely miss the point. Her work focuses on the difference between two moral orientations - a justice and a care perspective rather than on the question of whether women and men differ on Kohlberg's stages of justice reasoning. The argument was not statistical - that is, not based on the representativeness of the women studies or on the generality of the data presented to a larger population of women or men. Rather, the argument was interpretive and hinged on the demonstration that the examples presented illustrated a different way of seeing. (Kerber et al, 1986:326-328)

She refutes the question of method and evidence by citing Nona Lyon's study (1963) that reports a systematic procedure for identifying justice and care considerations in people's descriptions of real life dilemmas. Sherry Langdale, in her doctoral dissertation, demonstrated that Lyon's method could be adapted for coding responses to hypothetical dilemmas. These studies and others confirm and refine the 'different voice' hypothesis by demonstrating that the justice and care perspectives are distinct orientations that organise people's thinking about moral problems in different ways; boys and men who resemble those most studied by developmental psychologists tend to define and resolve moral problems within the justice framework, although they introduce considerations of care, and the focus on care in moral reasoning, although not characteristic of all women, is characteristically a female phenomenon in the advantaged populations that have been studied. (Kerber et al, 1986:330)

Carol B. Stack's (1986) criticism contends that Gilligan theory derives a female model of moral development from the moral reasoning of primarily white, middle-class women in the United States. She states in argument, "As Black and Third World feminist researchers have emphasized, gender is a construct shaped by the experience of race, class, culture, caste, and consciousness." (Kerber et al, 1986:324)

Gilligan replies that to say social class and education contribute to moral development while experiences typically associated with gender are essentially irrelevant may say more about the way development is being measured than it says about morality or gender. What she finds puzzling in her critics position is their dissociation of women's experience from women's thinking - as if experiences common to women leave no psychological trace. (Kerber et al, 1986:326)

Linda K. Kerber (1986) argues that Gilligan's different voice slips close to feminist self-righteousness. "Historically the rhetoric of feminism has spoken with two voices: one that claimed for women the natural rights of all human beings and one that claimed that women were different from - and usually, better than - men." The other risk is one of romantic oversimplification. "If women can be counted on to care for others, how are we to deal with self-interest, selfishness, and meanness of spirit which women surely display as much as do men?" (Kerber et al, 1986:308,309)

Gilligan's reply to this is that she simply listens to and interprets what women are saying. There are no data independent of theory, no observations not made from a perspective. Data alone do not tell us anything; they do not speak, but are interpreted by people. I chose to listen to women's descriptions of experiences of moral conflict and choice, to attend to the ways that women describe themselves in

(continued...)

²(...continued)

relation to others, and to observe changes in thinking over time. (Kerber et al,1986:328)

She sums it up globally and simply with:

My critics and I share a common concern about the education of our women students, as well, I assume, a more general concern about the future of life on this planet. (Kerber et al,1986:332)

Chapter III

Women and science

Introduction

I begin in this chapter by examining science and women in science. I think the problems that women have had working with computers over the past few years are similar to those they have had since science and technology began and especially since 'modern' science evolved; science, technology, computers are part of a continuum. Therefore, I will start with an analysis of women and science by looking at the work of four female scientists, then I will examine the philosophies that have guided science to question why women do not fit into the traditional science mould, why there have been and why there are fewer female than male scientists now, what could be done about this, and whether something should be done about it. Since this thesis proposes using Carol Gilligan's 'different voice' of an ethic of caring and responsibility to develop a pedagogy for teaching women about computers, I will try to see if the same framework could be applied as a means of understanding the women and science problem.

There have been several approaches suggested for solving the women and science problem. One asks us to recover women of science from history: to find the women whose scientific contributions have been obscured or neglected by the mainstream historians of science. (See Appendix B for a short list of bibliographies on women and science) Within this framework, we can analyze women's participation in light of their limited access to the means of scientific production. This position takes in the view that perhaps women cannot do science as well as men, that there is something in the physical, psychological and intellectual nature of women that prohibits them from producing great science.

Then we could look at the current status of women within the scientific profession. This approach often leads to the conclusion that the absence of women relates to an access to education and employment issue and advocates a straightforward integration of women into science. I will examine four women of science to see if their contributions made a difference to either science or women's status in science.

Next there is the position that the sciences, most often biological and medical, have defined and redefined the nature of women, a position that Ehrenreich and English support in their book, *For Her Own Good: 150 Years of the Experts' Advice to Women*. This is tied to the analysis of the masculinist nature of science where we need to unveil distortions in norms and methods that have resulted from the absence of women in any significant role in the making of modern science. This analysis posits that it is not enough for women to be scientists if science is to proceed along its

present course; the task of opening science to women must be combined with the task of making science more responsible. I will analyze some of the philosophies which have governed science as it developed by looking at how science has been defined and how these definitions affect the bias (or perspective depending on the point of view) of those defining it. Then I will examine some of the critiques that have been made of science and various calls for change.

Four women in science

Using the 'access to education and integration of women' approach, I will begin by outlining the work done by four women scientists, Lillian Gilbreth, Ellen Swallow, Rosalind Franklin and Barbara McClintock. I have chosen these women because their achievements represent four different kinds of science done by women working within the scientific community. Women have been participating in science in North America and in Europe as the discoverers of plants, animal and astronomical objects, as creators of scientific theories, and as teachers, researchers, and authors of important works on science. Much of their work is not known however; some of their work has been obscured and their participation minimized. (Ainley,1990:18)

Lillian Moller Gilbreth (1878-1972) has been called 'America's first lady of engineering' for her work in modern industrial engineering. She worked with her husband, Frank Gilbreth, developing and expanding on the Taylor time studies of the early twentieth century. Lillian's emphasis was on 'the human element'; she has been called the best trained psychologist dealing with time-and-motion study at the time.

Her book, *The Psychology of Management* (1914), which developed from her Ph.D research was very important in the history of engineering thought. It addressed modern managerial practice in that it contained the basic elements of management theory. She was one of the first to see management as a problem of psychology. She also taught undergraduate and graduate courses at Purdue University in management and she pioneered work on improved lighting, reduced pollution, rest intervals and breaks, as well as incentives for workers. Women were beginning to enter the office and the factory and her studies were seen as benefitting them to a degree that no one had considered earlier. Another of her accomplishments, while not regarded as 'scientific' but reflecting on her incredible stamina to pursue a career outside the home was the fact that she bore twelve children, later immortalized in the book , *Cheaper By the Dozen* written by two of her children. Her husband died in 1924 and she headed their company, Gilbreth Inc. for decades afterwards. When she died years later, she was still seen as an adjunct to her husband - her work was obscured by marriage to a man in a similar field; marriage did not obscure Frank Gilbreth's work. (Trescott,1983:23-37)

Ellen Swallow was the first women to study chemistry at the Massachusetts Institute of Technology. She worked as a chemist on faculty and developed an interdisciplinary environmental science which she named as Ecology in 1892. Her interests encompassed the many connections with the environment - nutrition, air and water pollution, transportation, architecture, waste disposal, and industrial health and safety. She also thought that science should be democratized - brought to the people

and made popular. She spent much of her time travelling about, lecturing and setting up demonstration projects. Her science was practised by women and came to be called first, home ecology and later home economics. It never received the status of the other sciences and consequently many colleges and universities did not deem it sufficiently academic to offer on their campuses. She gave science to the people but in doing so it lost the veneer of expertise to which only the elite scientist can have access. (Menzies,1984:62)

Rosalind Franklin, whom James Watson disparages in his book, *The Double Helix*, was responsible for the discovery of the structure of DNA. Watson criticizes her for possessing the characteristics that, in a male, would be admirable - seriousness of purpose, autonomous behaviour, as well as a lack of 'femininity'. He maintains that she "had to go or be put in her place." This attitude toward women is: if they are normal women, they are abnormal people, while if they are normal people with ordinary technical interests and capabilities, they are abnormal women. They can't be both. It's a kind of double bind. (Martin,1985:32, Janeway,1971:103)

The fourth scientist, Barbara McClintock is an eminent biologist who won a Nobel Prize in 1983 for her research work with neurospora chromosomes in genetics. Her greatest accomplishment is not just her work as a product which gives us new knowledge about genetic transposition but her work as 'process'. "She has a way of coming to know things that is part artist, part rigorous scientist." Hers is a vision of science premised on order rather than law and on respect rather than domination. Central to this vision is her insistence that good research requires the willingness to

"listen to what the material has to tell you". (Menzies,1984:62, Keller,1985:138)

Her biographer, Evelyn Fox Keller, thinks that it would be "tempting indeed to call McClintock's vision of science 'a feminist science'. Its emphasis on intuition, on feeling, on connectedness and relatedness, all seems to confirm our most familiar stereotypes of women." But she cautions again that science has been defined by its past and present practitioners and anyone who aspires to the community must conform to the existing code. To be a successful scientist, one must first be adequately socialized so the inclusion of more women into science will not induce an immediate or direct change nor would most female or male scientists want it that way.(Keller,1985:173)

What I have tried to show in the brief outline on the four scientists above are some of the problems faced by women who enter science. Only one, Barbara McClintock, was able to rise above the fact of being a woman and achieve true recognition for her accomplishments and this was after thirty years of work and the awarding of a Nobel Prize. Lillian Gilbreth was regarded as an associate of her husband even though she survived him by almost fifty years and carried on their work. Ellen Swallow had her research on Ecology devalued as less than academic.³ Rosalind Franklin's achievements were not only denigrated but her demeanour and personal appearance were criticized for being 'unfeminine' thus preventing her fellow scientists from taking her work seriously. These four particular women had access to

³I have to wonder if the current interest in the environment will bring any credibility to her accomplishments or those of other women who have been working in this field for years.

a scientific education as well as employment in their fields but they all experienced problems directly related to the fact that they were women. Barbara McClintock was able to bring a new perspective to science and perhaps add to women's status in the field but education alone was not enough to integrate them into science.

The development and practice of modern science

To understand why women generally do not fit into the scientific mould, we need to look at what science is. Modern science developed in the western world in the late eighteenth century at the time many other changes were taking place: industrialization, new professions, the rise of capitalism. The establishment of Protestantism was a crucial factor in the transformation of science and technology. Before the Reformation, the strongholds of metaphysics and religion had been grounded on authority; this authority was now undermined and came to be associated with the past and defeat and science was associated with the forces that defeated it. Protestantism laid the cultural groundwork for modern science and technology which linked control of the environment to disciplined routine work. (Gouldner,1976:6,28, Keller,1985:61)

Where science had once attacked entrenched authority, it became the new authority. Science produced new male experts: professional physicians, psychologists, domestic scientists who each claimed to have a specialized body of scientific knowledge. Their whole careers rested on the legitimacy of their connections to science as well as the systematic elimination of the credibility of the old practitioners

in these fields who were traditionally women. (Ehrenreich & English,1979:28) So modern science began by first defeating an old order and then by replacing its specialists with its own.

If we look for an definition of what science is, we can start with a philosopher of science's explanation. Harold Brown tells us that we must have:

. . .an accepted fundamental theory [that] serves to organize and structure scientific research. The theory determines the meaning of observed events by providing the scientist with grounds for recognizing which observations are relevant to his research, which of the relevant ones pose problems, how the problems are to be attacked, and what counts as an adequate solution to the problem. (Brown,1977:100)

This theory must be 'value free' and in order that it remains so, we must begin by "suspending our preconceptions and beginning research with a wholly unbiased search for facts". (Brown,1977:100) But not everyone is deemed to be competent to conduct scientific research with this unbiased search for facts. Brown contends that:

. . . it does not imply that everyone is qualified to hold an opinion. Only those who have achieved practical wisdom, who have had sufficient experience to understand human behavior and have developed their ability to deliberate, are qualified to make ethical decisions. My proposal, then, is to take *the man of practical wisdom* [italics mine] as a model of the maker of crucial scientific decisions which cannot be made by appeal to an algorithm... (Brown,1977:149)

The key word here is 'man' and Joseph Weizenbaum reiterates and expands on this definition when he defines science as "games invented by men who use scientifically validated knowledge in a philosophy of reducing understanding to logical formalism." (Weizenbaum,1976:14,15)

This 'unbiased search for facts' is the myth of a value-free objective science which takes as its norm a view of the world in which any other perceptions are seen as deviations from this norm. But Carol Gilligan argues that "theories formerly considered to be sexually neutral in their scientific objectivity are found instead to

reflect a consistent observational and evaluative bias." When we can see that these perspectives are only *presumed* neutral, it enables us to see that the categories of science and knowledge are human constructions.(Gilligan,1982:6) This construction of science moulds objectivity, reason and mind as male while subjectivity, feeling and nature are cast as female.

In this division of emotional and intellectual labour, women have been the guarantors and protectors of the personal, the emotional, the particular, whereas science - the province par excellence of the impersonal, the rational, and the general - has been the preserve of men. (Keller,1985:6)

Beyond being just a male sanctuary, Marion Lowe writes that "science is seen as male, as an essentially masculine activity, not only because historically almost all scientists have been men, but also because the attributes of science itself are defined as the attributes of males". Evelyn Fox Keller examines how the twin goals of science - knowledge and power - have been transposed into objectification and domination. She acknowledges that most of our culturally validated intellectual and creative undertakings have historically been the domain of men. Scientific thought, however, is male thought in a way that painting and writing, which has also been largely performed by men, has never been. This is not to say that science is intrinsically masculine but there are factors that might lead us to believe such claims are true.

She looks to the 'network of interactions' that are the parts of the acquisition of gender identity when a boy is growing up - the psychosocial construction of what it means to be masculine. This examines a belief system that equates objectivity and autonomy with masculinity. The concept of power is related to establishing one's place in a hierarchy where the alternative to dominance is perceived as submission.

This is not to say that all men seek power or that all women do not but only that more men tend to be preoccupied with autonomy and seek it through mastery and domination. (Keller,1985:71-89, Wright,1987:10)

While many different objectives have shaped and continue to shape the practice of modern science, nevertheless it also needs to be recognized that one of modern science's predominant features has been the conquest of nature.

Since conquest is culturally associated with masculinity, the fact that many prominent scientists have frequently and publicly proclaimed the objective of ever-developing conquest of nature has necessarily strongly reinforced the masculine image of science.(Harding,1986:143)

William James proposed what he believed would be an effective 'moral equivalent of war', namely the conscription of young men to participate in perpetual all-out scientific-industrial assault on mankind's eternal enemy, the natural world. An obligatory two-year assault on nature would knock the childishness out of young men. James believed, turning them into masculine men, all the more appreciated by women as better teachers, husbands, and fathers to their children. So we can view science as the search to make sense of the universe and of our place in it, but also as the arena for man's battle with a female nature in which male characteristics of aggression, dominance and control are encouraged. (Harding,1986:2,149)

While tradition symbolized nature as a benevolent female, it also contained the implication that nature when ploughed and cultivated could be used as a commodity and manipulated as a resource. It depended on a masculine perception of nature as a mother and bride whose primary function was to comfort, nurture, and provide for the well-being of the male. Our society accepts and defensively asserts the

need for a severed connection between science and sensuality/nature between people who are good at dealing with things and people who are good at dealing with people. (Merchant,1980:8, Turkle,1984:197)

Scientific women who accept the paradigm

What happens to women who have chosen to go into science as a career? How do they fit into this culture? Many women who enter have simply been admitted to the masculine academic culture. These women become scientists by accepting the traditional way of doing it and do not change the male bias; they leave the ideology untouched.

This is not to say that women should go into a new field carrying the banner of change. Ursula Franklin makes some very relevant points about what science is, the power behind it and what this means for women when she contrasts science and technology with a woman's view. She uses an interesting 'immigration analogy' when she asks us not to expect help from women who have entered 'the technological order' and are trying to cope with a whole new and different way of life. She says they lose their ties with their natural community of women but it is also unfair to put "the major burden of changing the present system on those women who seek entry into it in search of advancement." (Franklin, 1984:85,86)

There is the view that women can affect transformations once they become a part of a community. But when considering whether women, once admitted to scientific fields, could effect change from within them, this ignores the effect of being

in any system of thought for a length of time and then being able to shake it off easily. "Tyrants - as much as slaves - tend to absorb and subscribe to the ethic which legitimates their position in the hierarchy." This is confirmed as continuing today when Mary Anne Dolan deplores how women admitted to positions of power "spent a great deal of time seeking out the nearest male authority figures" and that the women "have come to resemble the old male models". (Dolan,1988:21-26, Overfield,1981:246)

J. H. Mozans in *Women in Science* (1913) claimed that women can be both female and male and that any significant differences are the result of discrimination or socialization and can be helped by counselling, support groups, extra math and science instruction or special technical training. This leaves the ideology of science unchanged and puts the responsibility for change on the individual woman. These are the same tenets that Betty Friedan put forth fifty years later when she claimed that equal educational opportunities for women in the form of a liberal education would lead to equality for women in the workplace and professions, something that has not happened yet, more than thirty years since then. (Friedan,1963)

Need for a change to the monopoly

There is a need to critique and provide alternatives to the male monopoly on knowledge- and meaning-making. Gender ideology does not operate as an explicit force in the construction of scientific theories. Its impact (like that of ideology in general) is always indirect: in the formation and selection of preferred goals, values.

methodologies and explanations. 'Good' science corresponds to one's ideological and emotional expectations. "The data do not speak for themselves." No matter what women achieve, no matter what gains are made, while men remain in charge of the decisions about what is important and significant, they are able to decree women's achievement as unimportant and insignificant. And while they continue to do this, women continue to be oppressed.(Chesler,1985:182, Keller,1985:137)

This calls for a new vision of science that will incorporate female qualities and values as fundamental to the human experience because:

If these are left out of science, then science is 'partial' in two senses: it includes only a part, the masculine part, of human experience; thus it is also biased toward male concerns. (Wright,1987:11)

We need to rethink the sexual polarities and abandon the sexual division of intellectual labour. There are real differences in the ways males and females think and relate, and science has suffered from the exclusion of female traits. There is an alternative conception of scientific rationality emerging which is more holistic and less control-oriented and where some exceptional women are providing symbolic models of 'another way of knowing'. As Carol Gilligan points out these differences are not intrinsic in male and female beings, any more than a masculine bias is indispensable to science. A breaking down of these sexual polarities would encourage the growth of 'feminine' themes in science, just as it would allow all individuals greater freedom to develop currently male-or-female-identified intellectual and personality traits. (Wright,1987:11, Harding,1986:129)

Summary

If we look at science and the problem of women's position in science as to their fit or lack of fit within this mould, we can conclude there are two issues here: one, education aimed at integrating women into science is not the answer, or at least not the only answer; and two, at least some of the problems women are facing might relate to the one-sidedness, the male-only perspectives of science today. Changing the focus of science by integrating Gilligan's care and responsibility ethic might have positive implications for both science and women in science. What is needed is an opportunity for women to make a difference. In the next chapter, I will move from science as theory and research to the more practical aspects of technology and examine how technology has affected women and the connections between women. technology and computers.

Chapter IV

Women and technology

Introduction

This chapter will look at what technology is and how it is related to and associated with science. It will examine the development of technology, moving to computer technology specifically to show how computers developed and are being used today, especially in the workplace, and what the future indications are for computer use. Next, it will analyze women's relationship with technology and how this affects women working with computers now, their possible problems with computer technology, and some suggestions as to how this could be changed using Gilligan's framework of care and responsibility.

Technology defined

Science has been identified with the production of new knowledge while technology's purpose is not so much to discover new knowledge as to find new applications for knowledge that already exists. Technology (or as Jacques Ellul names it, 'techniques') does not rest on knowledge alone but is always put to

immediate use. Technology also poses the problems and derives general notions through repeated experiments but it has to wait for the solutions which science provides. (Wright,1987:13, Ellul,1964:7)

'Progress' is defined as an advance or development, especially to a better state. (Oxford English Dictionary) The idea of scientific progress has been connected with the rise of technology and the requirements of an early capitalist economy by scholars who have argued that the idea of the sharing of knowledge for both the construction of theory and the public good originated from the intellectual attitudes of sixteenth century master craftsmen, mechanical engineers, and a few academic scholars and humanists.

The absence of slavery, the existence of machinery, the capitalistic spirit of enterprise and economic rationality seem to be prerequisites without which the ideal of scientific progress cannot unfold. (Merchant,1980:179)

Ellul claims it was the bourgeoisie (the French equivalent of 'capitalistic spirit'?) who first promoted the advance of science, and technological progress became an objective of bourgeois money. However, by the middle of the nineteenth century, the focus had changed and Karl Marx was the first to reclaim technology for the workers. Drawn by self-interest, the ideal of comfort, for example, the masses went over to the side of 'technique' and society was converted. Everyone, state and individual, bourgeoisie and working class, agreed on its merit. (Ellul,1964:54,55)

The evolution of computing machines also began in the mid-nineteenth century - with Charles Babbage's work on the Analytic Engine and the progress of computer technology development has involved the work of hundreds of men from then to the present day. But if we search for women who have been involved in the

development and evolution of computers, there are only two who stand out or who have been noted - Lady Ada Lovelace and Grace Hopper. Augusta Ada Byron was the daughter of Lord Byron and a 'talented amateur mathematician.' She worked with Charles Babbage on his Analytical Engine by translating an article written by an Italian mathematician, adding notes and comments of her own.⁴ Grace Hopper is a mathematician of the present day who devised a compiler that would take computer instructions and generate an organized program. She has been credited with the early development of computer languages.(Augarten,1984:64-65, 214)

Present and future computer applications in the workplace

Computers, as we know them today, had their beginnings at the end of the Second World War spurred on by a need for the development of machines that could calculate and track the trajectories of missiles. In the forty years since then, computing capabilities have broadened and computers have moved into businesses and factories, into every aspect of the working world. The invasion of the microchip has been called the computer revolution, because like a political revolution that is an uprising or coup that changes the lives of the people concerned, computers have altered the mentality of the people living with them and they are impossible to hide away from. They are everywhere. Computers have automated production lines in

⁴ In reference to women's different voice, Ada Lovelace draws on woman's experience and woman's 'voice' to describe an abstract mathematical process by using a weaving analogy : "We may say most aptly that the Analytical Engine weaves algebraic patterns just as the Jacquard-loom weaves flowers and leaves." This quote does not mean that only women were weavers, but that perhaps only a woman would compare algebra to flowers.

factories and they are used in business offices as data processors to sort and file information, as 'number crunchers' in electronic spreadsheets, in telecommunications, and word processing. Surveys show that about 50% of businesses in North America are using computer technology now and this is expected to increase rapidly in the future. Optimists say several thousands of new jobs will be created by technology, pessimists say millions will be wiped out.

The computer was invented to serve the needs of an industrial economy but the world is moving into an new age, led by or some say, pushed by, the computer. This is the Information Age, where the majority of workers process information rather than producing hard goods. This process of handling the electronically produced data is turning workplaces into 'information refineries'. A refinery is defined as a device for removing impurities from a crude material; information refining is an electronic, computer-based process that takes the volumes of raw material from magazines, newspapers, reports, databases, etc. and converts them into electronic form, extracts the content units and recombines them into a new form that can be distributed in a variety of ways. The end product of this information refining can then be sold on the marketplace as a commodity, as a finished good or as input for another refinery. (Clippinger & Konsynski, 1989:74)

A study done for the Canadian Federal Department of Communications in 1980 found that information workers comprised at least 40 per cent of the information workers in the Canadian labour force compared to 29 per cent in 1951. This included those who produce this information, such as engineers and surveyors.

process it, such as clerks and managers, distribute it, such as teachers and journalists, and those who run the technical systems, such as machine operators and printers. (Royal Bank,1985)

This refined information, organized and synthesized no longer exists as information; it becomes knowledge. Personnel Journal calls knowledge the new yardstick of work. It labels the workers who utilise this material 'knowledge workers' and says that they will have to be handled differently from the way in which earlier employees were handled "because they will be high-tech types, smart and independent, they will demand more of a role in decision-making." They will also be more expensive to equip. In 1980, the average U.S. firm invested \$800. in equipment per salaried employees. That investment is expected to triple or quadruple within a decade. (Chicago Tribune, Aug.11, 1987)

We are mass producing knowledge and it has become the driving force of our economy. Peter Drucker notes:

The productivity of knowledge has already become the key to productivity, competitive strength, and economic achievement. Knowledge has already become the primary industry, the industry that supplies the economy the essential and central resources of production. (Naisbett,1985:16,17)

The philosophy of technology

When we analyze how computers are used now and how they will be used in the future we need to examine not just what technology and computer technology is, but what the underlying philosophy is. Technology is a system which includes the organization of work and not simply individual machines in isolation. As science is not value free, neither is technology and there are problems in a wholesale introduction

of technological progress just because it exists. Jacques Ellul sees technological progress as a destructive process that is taking society's traditional values while suppressing and destroying them to produce a sameness, "a monolithic world culture in which all nontechnological difference and variety is mere appearance." (Ellul,1964:x)

Another problem lies in the very question that was asked of innovative technologies during the past three hundred years, in both capitalist and socialist societies: do they contribute to economic gain or military power? This is technology seen as having only two dimensions: as a component of the economy or of the war machine. Alvin Toffler thinks new technologies will have to undergo far more stringent criteria - ecological and social as well as economic and strategic. (Toffler,1980:149)

Some critics of technology recommend implementation based not on what is technically possible but what is socially desirable. Arnold Pacey argues for a shift from the unspoken but nearly absolute priority of 'technical virtuosity' to the inclusion of 'user values'. Others approach the problem from different angles: Alvin Toffler calls for technology to be evaluated in terms of personal fulfilment and aesthetic achievement. There are many who are resisting the technological 'progress', those whom Toffler calls the 'techno-rebels'. He sees their resistance to 'runaway technology' as the answer to the threat to themselves and to global survival. They begin not with technology but with hard questions about what kind of future society we want. (Toffler,1980:150, 151, Wright,1987:10)

If technology, as broadly defined, comes with a broad base of assumptions, what about computers in particular? Alan Hald claims that personal computers are a liberating technology that offer an increase of autonomy at the personal level.

The only way you can move toward information-rich societies is through the worldwide expansion of individual freedoms. Technology liberates when we are free to choose how we use it, and its use gives us a richer choice of opportunities. Personal computing is a liberating technology. Entrepreneurs in the PC industry are, indeed, the revolutionaries of the information age. (Hald, August 1987:83)

Joseph Weizenbaum addresses technology in general and then computers specifically when he sees the development of technology in terms of tools created by man. "Man can create little without first imagining that he can create it...a tool is a model for its own reproduction and a script for the reenactment of the skill it symbolizes - it is also an agent of change." Like Toffler, he contends that any given use of tool, techniques or technologies can have both beneficial and detrimental effects at the same time. He takes this technology-tool metaphor into the area of computers when he points out that tools and original jobs for these tools are rarely created simultaneously. Once the tools have been developed, then professionals and even users shape the functions of these tools.(Weizenbaum,1976:18)

This holds true even more so for computers than for other technology because the computer is the all-purpose tool. New uses for computers arise constantly, evolving from the needs of the users. One example of a new use that was made possible by the computer is the electronic spreadsheet. Before Lotus 123™ and other similar programmes were developed and integrated into business offices, financial calculations had been performed, first by hand then by primitive mechanical adding machines. The introduction of the computer, a machine that can only do two things

basically, add and compare, but does them so quickly and so efficiently - has changed financial calculations from merely an accurate picture of 'what is' to a portrayal of 'what if?'. By manipulating the numbers on a spreadsheet, business forecasters are able to input multiple variables and make educated predictions on the future financial directions of their businesses.

The ways in which computers can be used is really limited only by the imagination. Right now on the S.T.C.U.M. buses there are large advertisements, duplicated in French and in *English*, promoting a government drive for increased science and technology education in the schools. They show a young girl about ten or eleven years old and underneath is written "We need your imagination".

Computer power

Some would argue that computers are *only* tools. They are tools in the way a stove is a tool for cooking and the recipes are the 'software' or programme that defines what can be done with the stove. As tools, computers are nothing more than the software that they are driven by but built into these software programmes is a hidden agenda. "The essence of the machine is its software, but the essence of the software is its philosophy." (Roszak,1986:64)

A large part of computer philosophy is connected to 'power'. The word 'power' is freely applied in the literature of computers. Sherry Turkle describes the computer: "The computer is a 'powerful tool' and it is fuelled by 'powerful theories' and 'powerful ideas'." She concludes her study of young computer users with,

“Computers are not good or bad, they are powerful.” They have the power that children aspire to: the power of always being right, quickly and absolutely. They offer a power of the mind. They can give us the power to process limitless information with absolute accuracy. But, this power, as a university dean of computer science pointed out, “...is like carrying a six-gun on the old frontier.” Turkle calls computers a metaphor for how we see ourselves and the six-gun is a very revealing metaphor for how we (both males and females) perceive computers. As guns are largely associated with men, computers are seen as tools/toys for boys and men. (Turkle,1984:298,323, Roszak,1986:65-67)

Computer pundits have been predicting that although computers are stuck with the stereotype of being toys for boys, this will change once girls, who have started using computers as early as kindergarten, have grown up with them. They see the problem as the need to remove “the lingering image many women have of computers as simply work tools.” (Bufalini, Aug. 22, 1987)

Computer articles with headings such as “Young industry aiming at even younger market” explain how the computer industry is focusing its marketing strategies at young people’s love of computers by stating:

Not only do the machines offer hours of enjoyment with the latest computer games software...but also they open up a new world where an otherwise shy teenager can make a new circle of friends through the shared passion of bulletin boarding. (Bufalini, Aug.1, 1987)

Bulletin boards are the electronic message centres where computer users with modems are able to connect with other users through the telephone lines to exchange messages and computer programs, etc. This circle of friends with their shared

passions certainly exists but while it is usually young, it is almost exclusively male, at least at the local level of bulletin boards. This is determined by users codes names such as 'The Avenger', 'Death Threat' and the avid interest in sharing GIF pictures (a highly sophisticated graphics medium) that are the new electronically created pornography.

Another article headlines: "Computers: technology is dominated by males" and claims that although both boys and girls are learning computer skills today, boys seem to handle the new technology better. (Markoff, Feb. 27, 1989) Boys are certainly collecting more of the GIF graphics than girls.

Stephen Bostock in "The Effects of Learning Environment and Gender on the Attainment of Computer Literacy" concurs that schools, home use and sexist ads contribute to social expectations that computers are a male activity. He says they are part of the "strange myth that computers are male domain". As well he thinks traditional computer courses discriminate against women with material that is too vocationally oriented. (Bostock, 1985:37,38)

Betty Collis reiterates this when she links gender-typed labelling of school subjects as relating to students' achievement and participation in those subjects. The computer-as-male association extends to the marketplace where males are seen more often performing computer related tasks than females by the media and where men are more likely to use computers at a managerial or expert level while women tend to use them under someone else's direction or for clerical work. In the home market, males again are seen as the predominant users and an Apple representative was

quoted as saying, "We do not feel that women represent any great untapped audience." (Collis,1990:279,280)

Towards a new vision

Heather Menzies sees the solution to the problem of women lacking power as lying in women working towards a new vision of science and technology. She calls for different measures to attain this aim. Margaret Benston in "The Myth of Computer Literacy" comments on the introduction of computer technology, "We are told over and over that the new technology is here and we must learn to live with it. The implication is that the new technology is impossible to resist or change." But time to assert human needs in the use of the new technology is at the design stage. She feels that women must develop a critical understanding of it as a social as well as a technical phenomenon believing that there is a surrounding aura of ideological expectation as well as a basic question of intent. Who controls technology? "At the level of business of institutional computer systems, there is no question that we are looking at a technology that is specific to our social and economic system." Benston thinks that women need enough computer knowledge to be confident in their ability to be critical of present technology and the power behind it. And Sherry Turkle uses a programming metaphor to describe the current situation: "Unless we can change the power structures behind computer power they will continue to reinforce and reaffirm themselves. For they are 'the strange loops' whose power originates from the fact they refer to themselves." (Menzies,1985, Benston,1984, Turkle,1984:220,

Bernard,1984)

Computerization of offices can be justified on the grounds that it will save money and labour while resulting in better quality work and executive decision making. It will supply information for other workers such as sales and public relations staff, and provide a way of assessing some types of productivity in the office. A variety of issues determines whether a person's work will be enriched or impoverished as a result of using computers in the office. Perhaps we should be asking of computer technology:

- Is the terminal there to facilitate the work of the employee or is the employee there to work on a terminal?
- Is the system complex and does it require extensive training providing the user with opportunities to learn more advanced skills?
- Does the terminal control the worker or does the worker control the terminal?
- Is the computer used to monitor a worker's behaviour?

There is a call for women workers to support each other, to work together and to question the roles of computers. If women take a strong position questioning the technology, they can ensure that there are fairer opportunities for all employees in the organization. (Gutek,1983:159-168)

Instead of considering the goal of the development of a computer system to be rationalization, the computer system should be designed as a tool for the creative human to help her in her job. The development should take its starting point in human qualifications such as judgement, intuition, ability to generalize and react to

new situations. The work processes should be designed to take advantage of these general human qualifications. This would imply better jobs and better products (eg. service, newspapers, etc. depending on the organization in question). System designers need to develop, as part of their professional ethics, a sense of responsibility to the individuals who actually use a system. In developing a new system, they should work actively with unions and employees whose jobs will be affected. Many of the jobs affected in office work are jobs performed by women who do not have decision making authority. The ethical responsibility of system designers, analysts and programmers must extend to include the people who actually use the system and carry out a job, not just to people in positions of authority. (Olerup, 1985:99,189)

Summary

Science, technology, computers are all part of a continuum heavily weighted with male perspectives. As there are problems in trying to integrate women into science through education alone, so education continues to fail to empower women in the technology and computer arenas. While studies show that children start out in school with equal or similar interests in computers, these interests diverge by adolescence, and computers become the toys and tools of males. Females need more than just a knowledge of how computers work, they should be questioning how computers are being used and will be used in the future. Applying Gilligan's ethic as the framework for questioning all aspects of computer use might have positive implications not only for computer design, development and use but for those of science and technology as well.

Chapter V

Women and education

Introduction

In this chapter, I will first analyze some of the problems for girls and women that exist within the education system itself, showing some of the obstacles that girls face in education without even introducing the compounding effects of science, technology and computers. Next I will look at some of the attitudes held *about* women and *by* women to see if women have different qualities that could make a difference in how computers are used. I will begin by examining some of the negative attitudes that may affect women's computer learning starting with the 'women and math problem', and then some personal factors and barriers. Finally I will examine some of the positive values that Carol Gilligan claims women have to see if these could have any bearing on what women might bring to the computing world. I will conclude with some of the ways for implementing change that women are suggesting.

Women's lack of voice in education

Women have experienced problems within the frameworks of science and technology; they have also had problems within the education framework. The assorted theories and educational practices and the assumptions on which education rests share common features; it is a paradigm shaped by males. (Spender,1981:157)

Traditionally, men have been the gatekeepers and men consult only men in making educational decisions. Male experience is therefore the norm, the yardstick against which any female experience that is different is found to be deviant. The consequences of women's exclusion from being a part of this decision making process is that women have not had "a full share in the making of what becomes treated as *our* culture, their full share in the making of what becomes *our* education". (Smith,1975:353-369) So culture and education only belong to women inasmuch as they have been defined, shaped and controlled by men who have traditionally been the decision makers in the administration of the schools.

As well, Dale Spender points out, when education is defined and limited only to that which takes place within educational institutions, any learning that takes place elsewhere is not worthy of attention; it is 'non-data'. (Spender,1981:155)

There is an analysis of how girls and women have been shown in the school textbooks with women falling into three categories: there is the derogation of women where women are shown as subordinate or decorative, the invisible women - books do not focus on women at all or they point to the insignificance of women. This is classic stereotyping - the setting up of a point of view which creates categories of

individuals hierarchically related to one another and where one group is bound to be presented as dominant ideologically. (Scott,1980:97-119, Lorimer,1979-80:25-45)

This lack or misreading of women's roles conveys certain messages to girls: women did not shape history or they were present and their contributions were secondary and domestic in nature. From this, we have to wonder if girls become what the messages of the schools would have them become? (Kelly,1982:163-181)

As well, the language of the textbooks - the use of male pronouns and nouns conveys the message that only males act or are important. This is what Spender calls the man made language that makes women and their experience invisible. This is a crucial area and although the elimination of sexist language will not mean the end of a sexist world, it is quite clear that sexism will not disappear while sexist language continues to be used. Attempts are being made to write material which contains more positive images of women, but this is only a partial strategy as we are surrounded with sexist imagery and some slight changes in educational materials will not necessarily alter our world view or even undermine sexist ideology. (Kelly,1982:163-181, Payne,1980:36, Sarah,1980:160, Spender,1980:165-173)

Teachers themselves unconsciously reinforce this sex role stereotyping. The teacher with egalitarian values may start with the intention of treating the sexes in the same way but it is the students themselves who make this difficult or even impossible. By the time children enter school, it may be too late to make a difference. Children pick up gender identity around the age of three when they learn their different socially sanctioned roles. (Lobban,1978:50-61, Sarah,1980:160)

Problems with computer education in the schools

The installation of computers into the schools at the elementary and secondary levels has been a process charged with complexities which educators, parents, and other interested onlookers, such as the computer press, have been quick to comment on. There has been fierce competition among the major computer companies such as Apple, Commodore, Radio Shack and IBM who offer schools cut-rate deals hoping to instill a brand loyalty among students that they will carry with them. Here in Quebec, there were political decisions that implemented a school computer system made in France that would not run much of the popular American based software.

Many high school computer science classes focus on the programming in BASIC and other computer languages once known only to the programming elite. It has been estimated that if students were to be divided into those who show particular interest in learning how to program and those who do not, boys would constitute about one half of the interested group in the first grade, about two thirds of the interested students in the sixth grade, and about four fifths in the ninth grade. (Maynard, Sept. 1986:19, Alper & Holmberg, 1984:74)

Both Leah Moran Rampy and Sylvia Stalker presented papers at the National Women's Studies Association Conference held in June of 1983. Rampy's preliminary research on the distribution and use of computers in public schools indicates the existence of socioeconomic, regional, and sex inequalities. She found that within schools owning computers, inequity for girls is found in the allocation of work time at the machines. There is also a lack of programming classes for all students. Stalker's

stress is that women stand to lose a great deal in the information revolution if they fail to master computer technology. (Rampy,1983, Stalker,1983)

Seymour Papert stated: "I shall concentrate on those ways of thinking that I know best...[what] I know best how to think about is mathematics." (Papert,1980:10) From this statement, he goes on to explain his LOGO computer programming language for children and how he developed it. He explains how he fell in love with 'gears' at the age of three and then he joyfully celebrates his love of mathematics for two hundred pages in his book on LOGO programming, *Mindstorms* (1980). It is clear that Papert appreciates and has a great affinity for math and a mathematical way of ordering the world and thinks that everyone else should too. This is his attitude and one that prevails, to a great extent, throughout the school system, even though the initial enthusiasm over LOGO has faded considerably.

But girls have had a long history of lower math achievement, especially at the secondary school level and in higher education. Women have low representation in math, science and engineering and this continues for the new information technology. Since testing can find no cognitive differences between girls and boys, it is thought, therefore, this discrepancy must relate to educational and social attitudes. Scott Gardiner (1987) quotes Sheila Tobias' study on girls and math when he expands on how girls are prevented from entering major professions because they have not taken enough math courses. Since there are no cognitive differences, he concludes that learning math is more a matter of attitude than aptitude. The American Association for the Advancement of Science concurs when it finds that men's advantage in math

is nearly gone but that parental attitudes need to change as there is still more encouragement given to boys to study technology. (Bostock,1985:37, Gardiner,1987:2, Los Angeles Times, Jan.16,1989)

The majority of school computer science or computer studies require mathematic prerequisites, have a mathematical orientation and are taught by instructors who were originally mathematics teachers at the school. A study by Elizabeth Fennema (1984) shows that male superiority is always evident by upper elementary or high school and she relates this to better spatial visualization on the part of males. She thinks that the affective variables: feelings, beliefs, attitudes lead to high anxiety in girls as society's math stereotyping of males leads to girls' lower self confidence. She concludes that the most important component of the learning experience is the teacher. "If schools cause the problem it means they can solve it." So the messages given here are: there are no cognitive differences between girls and boys, girls attitudes must change, parents must encourage girls as well as boys, teachers have to change girls' attitudes. What they are all saying is: girls *must* learn math, everyone must learn math; it is necessary for the technological world we are entering. (Ainley,1990:276, Fennema,1984:138-161)

Judith Finlayson reaffirms this position when she says that for young women, overcoming a fear of math will be crucial to success in an increasingly high-tech society. She goes on to say that "a minimum of high-school math is often required for entrance to university courses such as nursing, teaching and law as well as psychology and sociology..." But then she continues by quoting information from

Statistics Canada that shows that women are not making 'serious inroads' in the male dominated fields of business, medicine and law but remain concentrated in the traditional fields of education, nursing and the humanities. Obviously, the women who enter the (women's) courses are passing their prerequisites in mathematics so perhaps a negative attitude or capability in math is not the only problem. (Finlayson,1988:10-25)

Perhaps a high math competency is not always a necessary component of the technological society. We need to recognize that perhaps math is something else - a gatekeeper. Professor Chandler Davis of the Department of Mathematics, University of Toronto states:

The main function of mathematics in advanced capitalist society is the maintenance of social stratification. Our courses..are the feature of formal education which performs the most decisive winnowing of students. Society tells the student, even the working class student, you may be a dentist if you pass the test, you may be a military officer if you pass the test...and the decisive test is in math...The aridity of our courses, their remoteness from students' human concerns—together, of course, with their difficulty—make them especially forbidding, hence especially good as selectors of students with superior capacity for self discipline (sometimes called repression).

Math serves to 'weed out' those not proficient at taking math tests, especially at the level of engineering, computer science and other technology related fields.(Hacker,1983:38,39)

Elizabeth Fennema refers to an American sociologist, Lucy Sells, who calls mathematics a 'critical filter' but Fennema continues: "Without mathematical knowledge and skill, women will never be able to achieve equity in society." (Fennema,1984: 138) She is saying that math has been erected as a barrier; the way over the wall is with strong mathematical skills and the onus is on women to conform.

What I see here is a syllogism: women cannot do mathematics, computers require mathematical knowledge and skill, therefore women cannot use computers effectively.

Introductory computer classes teach technical concepts such as number theory on which binary codes are based, furthering the idea that computers are inaccessible and difficult. They serve the purpose; they have kept the ranks of computer professionals small enough to maintain high salary levels. These barriers in the computer field are artificial; they were added as screening mechanisms when characteristics important to success were misunderstood by those who controlled the field. (Brecher,1985:79, Weinberg,1987:282)

But are computers really only math machines? Do people need advanced math training to use computers effectively? Absolutely not! Computers really have little to do with math these days. Even programming in a high-level language is not particularly mathematical. Michael Crichton puts it succinctly, "It's much more like talking to a cranky aunt who doesn't hear well. You say, 'I've just been outside,' and she replies, 'I never told you to hide.' *That's* what programming is like." (Crichton,1983:90) Computer programming requires skills such as careful planning and implementing step-by-step instructions rather than the ability to manipulate abstract mathematical formulas.

Sherry Turkle speaks of a 'soft' mastery of computers as opposed to the 'hard' mastery of computers through mathematics and says that the conventional way to do math closes doors for those who relate to the world through intuition, visual impression, words or a 'beat'. (Turkle,1984:122)

If we look for personal attitudes that are also barriers, we see that differences in computer learning between boys and girls does not really become apparent until the secondary level. Given the 'girls-cannot-do-math-therefore-girls-cannot-use-computers' above, it is not surprising that these obstacles are firmly in place. Some of the attitudes of girls that manifest themselves at adolescence are:

- ♀ lower self-confidence - a feeling of being less capable of doing academic work in general even though they earn better grades than boys in many cases.
- ♀ the 'we can, but I can't' paradox - girls respond positively to a survey on whether women are as computer-competent as men, but when asked about their own career expectations, they do not apply this to themselves. This stands as a powerful barrier to equitable computer access, no less because it is self imposed.
- ♀ the perceived irrelevance of computer work. Many girls believe that computer classes are unnecessary for them in their careers. A major reason for this is that many adolescent girls are less career-motivated than boys in forming career goals and do not see the necessity of developing a strong base for future professional or vocational development. (Collis,1990:280,281, Carney,1986:38)

There are also practices regarding the organization of learning that affect female attitudes towards computers. Computer programming courses are often regarded as advanced studies and reserved for the best math students, traditionally assumed to be male. Computers are often located in computer labs in the math or science departments of schools and are staffed by male teachers from these departments.

Many computer programs, educational or otherwise, have an arcade-like, inherent violent quality - games that involve shooting or 'zapping' objects. Much of the language used with computers employs words like 'kill', as in 'to kill this screen...','hit', 'hit any key...', 'joystick', words and phrases that girls do not feel comfortable with.

Boys seem to be more aggressive in demanding computer time and many girls step aside in the face of these demands. Extracurricular use of computers is overwhelmingly male. Boys tend to achieve a higher status among their peers for knowing about computers but girls do not get the same encouragement from either their male or female friends. Females are also more likely than males to associate social and academic stereotypes with computers users. (Ainley,1990;272-278. Carney,1986:38)

Positive attitudes that may enhance women's computer learning

Before I talk about some of the positive values that women might bring to computers and computer learning, I think it is necessary to consider how values defined as belonging to women can be used against women by labelling them.

What is the danger with respect to the emancipation and liberation of women in focusing on female values? Shall we suddenly see ourselves put on a new pedestal with a very narrow freedom of movement: a pedestal built of new dogmatic statements about women's biology, women's character, and, worst of all, women's nature. The danger is that when we talk about difference in sex, the masculine universe of interpretation has a tendency to use this information to label women, to define their God-given place in society and put them in new boxes. (Gronfeldt,1985:205)

When Carol Gilligan argues that women see the world in terms of connectedness and relationship she is not saying this is women's nature but this is perhaps a part of our socialization process. She speaks of the way that males feel comfortable working in autonomous situations but that females feel threatened by isolation and she also demonstrates important differences in the responses of both sexes where women perceive competitive success as threatening. Linda Lewis argues from this point that if men see the world in terms of their autonomy, then males may more readily embrace computer technology because they view it as enhancing autonomy and power. Women, on the other hand, may display reluctance because they view technology as distancing them from others. (Gilligan,1982, Lewis,1987:273,274)

Sherry Turkle defines two styles of computer learning - 'hard' mastery where the 'hard' style of mastering and manipulating computers is mostly done by males and 'soft' mastery which is mostly done by females involves a more intuitive and personalized approach to learning what computers can do. (Turkle,1984:104-109)⁵

Carolyn Merchant and Marge Piercy view connectedness as a challenge to a 'mechanistic technology', and view women's more 'holistic presuppositions about nature' as being revived in ecology's premise that everything is connected to everything else and in its emphasis on the primacy of interactive processes in nature. They contend that all parts of nature are dependent on one another and mutually affect each other and the whole. (Merchant,1980:99, Piercy,1976)

⁵ I will give an example of Turkle's hard and soft mastery learning in Chapter VI to illustrate different learning styles.

Arnold Pacey thinks that a profound contribution that could be made toward creativity in science and technology would be to encourage the involvement of women in this field at all levels. "Not as imitation men, copying all the absurdness of men, but to challenge and counteract the male values built into technology." He calls for women's sense of responsibility to be used to develop the 'human' side of technology. (Pacey,1983:107)

Joan Rothschild refers to the discipline that is required in any individual realignment of values by using words such as 'dialectic' or 'reversal' both of which imply an interaction between different sets of values. She refers to a "dialectical vision of...technology" in which the conventional values of male and female interact in a new creativity. (Rothschild in Pacey,1983:112)

Is education the answer?

I am arguing for the inclusion of women and their values into computer technology and the empowerment of women through their mastery of computer technology. At the same time, women are being told that their empowerment lies in more education, and education of a technical nature to solve any of the inequities of the marketplace.

This message was stressed at a conference organized for business women in 1984 by the Concordia Centre for Management Studies to educate women and help those in managerial and executive positions to feel less isolated. Emphasis was placed on the fact that women have to understand how technology works since the new

technology will change jobs and the nature of skills needed. The conference stressed the need for more education as there is an increasing polarity between the educated and uneducated. Women were told that they should head for the computer science department of the nearest university and prepare themselves to give battle in the corporate arena. (Temback,1987:270-276, The Gazette, June 22, 1984) 'To give battle in the corporate arena' - it is clear to me on whose 'field' the 'battle' is to be fought. This is not a woman's analogy.

But not everyone agrees that education is the answer, or the only answer, to the problem of women lacking equity and/or power in the workplace. Kate Millet does not agree that all will be well once women have a technical education and get involved in technology, as she sees the problem lying outside the technology itself: "There can be no easy solutions for the transformation of a patriarchal society." This is a society which moves to exclude women from science and technology on the grounds that women are 'too practical' for science and they are 'too idealistic' for technology. (Spender,1985:44, Wright,1987:17)

Women have been working with technology in the workplace for over a hundred years. The first technological revolution in the office took place from 1880 to 1920 and saw the development and consolidation of the mechanical office and the entry of large numbers of women into the paid-labour force. In the then newly organized offices, women could hold clerical jobs -new, deskilled positions - as long as it was clear they could not advance to managerial positions. There are two lessons to be learned from the first technological revolution. One is that the feminization of

office work did not change women's position in society and, secondly, there is no automatic liberating quality to new technology. (Bernard,1984)

Implementing change

Clerical jobs, possibly because of identification as 'women's work' have been undervalued historically in terms of status and respect. Judith Gregory does not see the restructured, automated office of the future as changing this tendency. In fact, as clerical jobs are broken down and deskilled and secretaries are redefined as 'word processors', there is the possibility that inequitable treatment will intensify. How can this be changed? She points out that in the 1970s women began to organize for equal pay and equal opportunities. In the 1980s women continued to organize to influence automation - while the technology was still in flux - to ensure the health, well-being, and employment of women office workers. She sees the necessity for collective action in the form of unions as being as apparent to the clerical workers of the 1980s as it was to the industrial workers of the 1930s. Her answer lies in the unequivocal need for unions to protect women. (Gregory,1983)

Maria-Luz Samper also suggests the implementation of a European union model which finds that the response to technology cannot be an individual one; unions must work to organize employees in the service sector. They need to become more sensitive and responsive than traditional male-dominated unions have been to the specific needs of women and minority workers and must make a concerted effort to organize professional and technical employees. She sees a need for union

cooperation across national borders, in order to deal with automation in multinational enterprises and finally, unions need to look for political allies. (Samper,1987)

Besides union protection, Heather Menzies says change will depend on early and effective action on many levels: by governments, employees, and women themselves. In terms of concrete action, she proposes broad governmental initiatives with specific recommendations related to education, job counselling, and employment security. (Menzies,1981)

At the Annual Conference of First Ministers in 1986, the theme was *Towards a Labour Force Strategy; A Framework for Training for Women* and it stressed, first of all, an equality in education and training, and within that a framework for action. This framework addressed the need for changing attitudes, the availability of non-sexist counselling, initiatives to be taken to increase women's positions in non-traditional areas, changes in the learning environment, training programs and aids, access to training, data collection and evaluation, intergovernmental cooperation, and, perhaps most of all, a commitment to action. (Annual Conference,1986:4-7)

Summary

As men have shaped the development and use of science, technology and computers, so they have shaped the educational institutions, and the computer education that takes place within them. As well, mathematics which has long been a barrier in girls' education has been deemed a necessary component of computer learning. There are other negative barriers that girls might be bringing to computer

education but there are also some positive ones. This is an argument for the inclusion of the values of Gilligan's ethic into computer education: those of connectedness, working together in a give-and-take attitude and a sense of responsibility.

There is also the issue of whether these values can be integrated into the workplace through schooling alone. The two previous chapters called for a questioning of the present values in science, technology and computers and the integration of the more positive ones of Gilligan's framework. In this chapter I have suggested that not everyone believes that change can take place in education alone and that some call for the additional support of unions, government, training programs, etc. motivated by a commitment to action.

Chapter VI

A proposal for introducing computers to women

Introduction

Given that women have had problems integrating into and gaining access to power in the fields of science and technology, as well as that of education, how could a new pedagogy be shaped for educating women about computers: one that would genuinely include women and empower them? This chapter is a proposal for introducing women to computers taking into account chapters II, III, IV and V and applying Carol Gilligan's framework to the educational process. To construct a new model for computer education, it is not necessary to 'reinvent the wheel'. What I am proposing is a collective, collaborative model that connects the theories of others - educators, philosophers, etc. but uses Gilligan's framework of a different *voice* and is informed by this perspective to construct a computer education pedagogy in a different *format*. I also look beyond the educational framework to examine the future directions of the workplace to see if this different educational format might fit into the larger framework of work.

Transforming perspectives

Gilligan's framework is one of transforming perspectives by speaking in a different voice and seeing in a different way. Since women and men are significantly different for whatever reason, and since they qualify meanings of things differently, many women will consistently be at a disadvantage unless a different educational practice is acknowledged for teaching women.

This presents a strong argument for the development of alternate teaching and learning strategies founded on the premise that women and men have differential access to certain understandings. One of Gilligan's findings is that women view the world in terms of connectedness and relationship; another is that males are generally more autonomous while women feel threatened by isolation.

If men tend to see the world in terms of their autonomy, then males may more readily embrace computer technology because they view it as enhancing autonomy and power. Women, on the other hand, may display ambivalence or reluctance because they view the technology as distancing from others. (Lewis, 1987:273,274)

Building a new educational model

Dale Spender looks at the philosophy of science as seen by Thomas Kuhn (1972) for the construction of a new model. Kuhn suggests that the history of scientific knowledge is the history of the shift from one paradigm which no longer adequately explains and which contains too many inaccuracies and contradictions to be tolerated, to a new paradigm which takes account of more evidence and which offers a more comprehensive explanation. She speculates whether this model could be applied to education and proposes an end to hierarchies and standards, as they

have been constructed, on the grounds that they are *not* an inherent part of learning, but of a stratified society. To replace them, then, would be new knowledge produced in a different way: "a 'collective' knowledge, 'made' rather than 'received' by all those who participate." (Spender,1981:167-172)

Blending the theories of earlier educators, in the traditions going back to Freire, John Dewey and even Socrates of involving students in constructing and evaluating their own education, Frances Maher sees a pedagogy of women as collaborative, cooperative and interactive. It should be one that aims for the construction of knowledge from multiple perspectives through cooperative problem solving - a truly interactive pedagogy - reshaped to accept multiple viewpoints. It assumes that each student has legitimate rights and potential contributions to the subject matter and one of its goals is to enable students to draw on their personal experiences. (Maher,1984:101-103)

It would be encouraging to think that a new paradigm could be constructed and implemented without causing hostility through a perceived unseating of traditional pedagogy. Jacques Ellul speaks of how transformations take place in the field of education.

After the general direction given by initiators (like Decroly or Montessori), it is the findings of thousands of educators which ceaselessly nourish the improvement of technique. In fact, educational systems are completely transformed as a result of practice - without any one's being quite aware of it. (Ellul,1964:86)

Introducing computers to women

Before designing a pedagogy for introducing women to computers or computer literacy, I will explain why I think it is necessary to teach women computer skills, who are the women I am addressing, and what is meant by computer literacy.

There are those who argue that education is a component of, but not the only solution for the problems that women face: there are economic and politically related issues as well and Dr. James Anderson claims: "we should be arming them with correct kinds of skills to prepare them to be marketable when they leave." (Anderson,1990:8)

But if knowledge is power, and skills attained through education are the foundation of this knowledge, then there is a need for computer education for women so that they have a route to marketability and empowerment. They need this education, at the social level, for economic efficiency and for the safeguarding of democratic rights against the misuse of the new power and, at the individual level, because it opens the door on new possibilities of efficiency, communication and creativity. What it avoids are the social and intellectual constraints which (computer) illiteracy imposes along with undesirable attitudes and anxieties. (Bostock,1985:37)

If, for no other reason, we can use education as a means of avoiding Jacques Ellul's pessimistic view of technology which he has when looking at *man's* role in the future.

In the future, man will apparently be confined to the role of a recording device; he will note the effects of techniques upon one another and register the results. (Ellul,1964:93)

Hopefully, women who have an understanding of and are comfortable with computer technology will not see themselves as mere scorekeepers (recorders) of technological processes. Why should they when keeping track and recording results are the sort of functions that computers perform admirably, eliminating the need for *any* human beings to execute these tedious chores.

This thesis explores teaching adult women about computers - women from all walks of life because computer skills are needed by people who are presently outside the labour force or who are ineligible for training programmes because they only work part time. Also, there are low income women and women with family and childcare responsibilities. It does not necessarily exclude girls in school but rather focuses more on post-secondary education.

Everyone who teaches about computers has his or her own definition of computer literacy:

[It] includes not only skills necessary to operate a computer and knowledge of principles of hardware and software but also an understanding of major computer applications and their social implications. (Bostock,1985:37)

... generic educational courses such as some basic scientific training, training in computer literacy, exposure to different systems of logic and training in communication skills, written and verbal. (CASW,1982:10,11)

At its most stimulating, computer literacy combines plenty of hands-on experience with a gamut of discussion topics: the history of computing, the handling of the machines and information age concerns such as privacy and computer crime. (Maynard,Sept.1986:19)

These definitions are valid and each needs to be incorporated into a literacy course, but so often we are looking in the wrong places for the key. As in a liberal education, what is important in using computers is knowing how to get answers and more important, what questions to ask. (Pournelle,1986:49) To 'train' a person in wordprocessing skills pertinent to one software programme or one operating system

such as WordPerfect 5.1 running under IBM DOS is only a bandaid solution to the larger problem. We need to show students how to find their own computer knowledge.

Learning styles

Deborah Brecher has been involved with teaching women about computers using an approach based on what she sees as learning styles that are distinct in men and women. Studies show that there are two styles of teaching young boys and girls. Sherry Turkle calls these two - 'hard' and 'soft' mastery where the 'hard' style of mastering and manipulating computers is mostly male and the 'soft' style which is mostly female involves a more intuitive and personalized approach to what computers can do. Turkle believes that girls are taught the characteristics of 'soft mastery' by a socialization to the practice of 'give and take' and boys to the 'imposition of will.' Hard mastery shows itself as 'explain to me how to do it and I'll do it' and soft mastery as 'show me and I'll watch'. She illustrates this by using the example of two young *boys* programming computers to show, first of all, as Gilligan says, "The different voice is characterized not by gender but by theme": and secondly, how there are different kinds of learning styles. 'Jeff' displays all the traits of traditional computer programmers, who also traditionally have been male. He uses the style of hard mastery which is the imposition of his will over the machine through the implementation of a carefully thought out plan. The program is the instrument of

premeditated control and getting it to work is the ultimate goal. 'Kevin', on the other hand, uses a more interactive soft mastery where he is more like a painter who stands back between brushstrokes, looks at the canvas, and only from this contemplation decides what to do next. Turkle calls hard mastery the mastery of the planner, the engineer, while soft mastery is the mastery of the artist: try this, wait for a response, try something else, let the overall shape emerge from an interaction with the medium. She describes it as more like a conversation than a monologue. These are similar terms to those that Evelyn Fox Keller uses to describe the biologist, Barbara McClintock who maintains that good research requires the willingness to "listen to what the material has to tell you". Soft learning, which most women are comfortable with, is a visual- or process-oriented style. Women prefer to know the answers to why, where, what, when and how before jumping into learning a new skill. They want to see the whole picture - to have a holistic view - and to see the connections between the different parts first. (Gilligan, 1982:2, Brecher,1985, Turkle,1984:109, Keller,1985:138)

Men are often more comfortable with the traditional hard learning style, where linear-oriented learning takes place. This style teaches by using a schematic-based approach and generally does not explain in terms of a larger context. Unfortunately for many women, this is the way computer literacy, as well as all other computer learning, has been taught. These are the same teaching methods geared to male learning that have been used in math, science and technology and women are inevitably disadvantaged.

Women are just as capable - but many have to learn differently. Barbara Call speaks of how everyone knows that men and women are different but when you start talking about it in terms of learning styles, everyone gets nervous. They think you're talking about brain size or excelling. People with similar talents often learn in different ways. Jane Roland Martin illustrates this when she speaks of learning to play tennis. Female students often have trouble learning to serve the ball. Tennis instructors will ask their students to: "Watch my racket as I serve the ball." The serving motion is similar to throwing a ball and by asking the students to *watch* and learn, it assumes they have all had prior experience in ball throwing. If the female students in the group have not had similar ball throwing practice as their male counterparts, they will almost surely fail to learn to serve adequately in tennis just by watching the motions of the instructor. Martin maintains that to reach this goal they must be given special instruction which takes into account their past experiences. She speaks of learning finally taking place when the instructor "analyzes the serving motion verbally, introduces a meaningful metaphor, tells me to listen to the sound the ball makes, or takes hold of my arm and puts it through the correct motions." (Martin,1985:19,20, Call,July/August 1988:6-8)

Teaching styles

If we are going to teach women about computers, the goal should be to create a teaching style that is compatible with these students' learning styles. James Anderson, a recognized expert in the field of cultural diversity at UIP Center for

Teaching Excellence at the University of Pennsylvania, points out that, as teachers, our preferred teaching style is very often our preferred learning style; we need to rethink the way we present information. (Anderson, Forum 1990:7) The implication here is that perhaps the male educators who are teaching about computers replicate their own learning styles as their teaching styles. If they learned computer technology through Turkle's 'hard mastery' which is highly likely, this is the way they will teach, assuming this is the way everyone learns best. This teaching style would, of course, also apply to female teachers who have learned about computers through the traditional channels so perhaps what we need to look for are female computer teachers with non-computer science backgrounds; women as educators who are sensitive to women's needs. This presents the difficulty of finding suitable tutors: those with skills in adult education are very often not yet expert in computing and vice versa.

One of the most important things for educators who are working for equality and empowerment of women is to look for the silences in the classroom. Women, especially adult women, are so often accustomed to remaining silent in mixed groups so that even in all women's groups, their silences remain as barriers to their learning. These passive silences are often even more evident with the constraints imposed by computer technology where the computer, just by being there, demands a fearful and respectful awe. Maureen Mchugh reminds us of the radical pedagogy of Paolo Friere (1972) which "seeks to break through silence and passivity to empower groups". The traditional lecture, in which the teacher-authority "makes deposits of information into

the empty vaults of the student's minds" reinforces passivity in students and may be especially inappropriate for women students. Confrontational and rhetorical approaches undermine women's participation; classroom discussions which are conducted to reward assertive speech, competitive interchanges and impersonal styles are seen as masculine.

Nurturance and encouragement should become the predominant characteristics of the learning environment. Some suggestions to teachers for giving voice to students might be:

- ☐ Cultivate the habit of noticing the details of interaction in the classroom, including seating, eye contact, and the pattern of calling on students.
- ☐ Raise the question of silence and what it means.
- ☐ Invite students to help figure out the tacit rules of the classroom and to devise ways to encourage more participation.
- ☐ Create a context where people have names and distinct identities.
- ☐ Talk privately to students who are always silent and ask if there are ways to encourage more participation. (Mchugh,1990:10,11)

Peer teaching is another way computer learning could be taught. As Seymour Papert (1980) claims, "the best learning takes place when the learner takes charge". We could consider using peer training to foster interpersonal support. Actually, as adults, the focus should be more on learning than teaching as the onus has shifted from the teacher to the adult learner; the challenge is now to learn on one's own or supported by peers.

We need to consider the physical environment. There is much concern today about 'ergonomics', the science of shaping the physical factors in the workplace for the greater comfort and safety of the workers with the ultimate goal of increasing productivity and the long term satisfaction of employees. The emphasis focuses on comfortable seating, good lighting conditions, considerations of physical safety, etc. While all these are important, a positive physical learning environment can be built for women learning about and with computers if we take into consideration some of their educational needs. It is important to avoid isolating students and, at the same time, pitting 'human' against 'machine'. It has been a common practice to install computers in a lab in rows with students working at individual computers. An alternative solution might be to use computer networks, cooperative activities, circular seating arrangements, and team projects to encourage communication among students. Then the preference for interconnectedness and sharing can be capitalized on to promote further learning and continued participation. (Lewis,1987:274. Bostock,1985:38)

A key element of women's computer education is the demystification of all that the word 'computer' signifies by combining theoretical and practical knowledge - the mix depending on the educational setting and the audience. Through this enlightenment can come confidence, then mastery and empowerment.(Rothschild, 1988:75)

Deborah Brecher (1985) has written a holistic book, *The Women's Computer Literacy Handbook*, about computers. It has clear definitions of computer jargon.

explanations of how computers work in which she compares their functions to recipes, thermostats, file cabinets, shorthand pads, magnets, calculators, mailboxes, bathtubs, and other familiar objects, and information about every aspect of computing, from programming to telecommunications. The book does not address any one computer system specifically but aims at increasing total computer understanding.

As Theodore Roszak (1986) pointed out earlier about the hidden curriculum in software, "the essence of the machine is its software, the essence of the software is its philosophy." If we want women to spend more time with computers and develop an interest in them, then there must be a shift from or finding an alternative to the destructive, violent, aggressive and competitive games that dominate the computer market. These programmes are designed by males, for males, and stereotypical masculine values are reinforced by them. The central theme of recreational software has often been criticized for its role in perpetuating racist and sexist attitudes that alienate females. As significant efforts have been made in the past to produce teaching materials that were sexually and racially non-biased, so efforts must be extended to computer software. We need to question if 'destructive' software has a redeeming value for either sex. "When we continue to use strategies and classroom techniques predicated on competition rather than cooperation, we preserve a macho perspective and fail to view females on their own terms." (Lewis, 175)

We need to consider the concerns and interests of women when teaching about computers. More women might be more interested in using wordprocessors if they could see how they could help them as an aid to writing. Many music and

graphics software programmes are being developed for those interested in these areas. Desktop publishing combines typography, graphics, writing and editing skills as well as page layout and, as word processors become more sophisticated, the desktop capabilities are included in these popular software packages as well.

John Naisbett sees music and the arts as a 'counterballast', a necessity, not just an option for a less technological minority:

Now that we are putting more and more computers into the schools, the last thing we ought to be doing is eliminating the high touch of music, the arts, drama, and literature. Instead, we ought to be preparing to celebrate a renaissance in the arts in order to balance all the technology we have pumped into this society. It is through the arts that we explore our humanity, our spirituality - the counterballast to having to live with high technology. (Naisbett:254)

I suggest that there is a route to and from the arts through computer technology. Computer generated art and music have come into their own as valid art forms and the computer is the creative instrument that shapes these forms.

Many women view the computer as just a work tool, a means to an end and not an end in itself. As one's interest in computing grows, interest in the computer as a learning tool often develops as well. While women may be quite indifferent to learning a programming language like BASIC or COBOL, some are caught up, first of all, by writing simple macros to speed up their word processing operations, then by wanting these macros to do more - faster, simpler and more elegantly. Somehow, using a macro programming language, even if it involves struggling with understanding 'variables' and 'system' versus 'state' commands becomes tremendously rewarding in its own right.

The home computer market - is this where women's interests lie?

There probably will never come a time when, for example, a woman will type all her recipes into the computer then, when she wants to make muffins, turn on the computer, access the database the recipe is stored in, retrieve it, print it out or try to cook while running back and forth to a computer monitor; this doesn't make any sense at all. In the early 1980s, there was a massive campaign by emerging computer companies like Commodore, Atari and Apple to capture the home market by promoting ideas such as recipe databases that women supposedly would use. That market died out because there was no demand or interest in these and similar applications. Now IBM has returned to this arena with the announcement of their new model PS/1 for the home market. This time they are offering a wider range of applications with telecommunications capability as well. While more women have moved to work outside the home today than ten years ago, perhaps there are now more reasons for buying and using a home computer: as an extension of the workplace needs, as a learning tool, and to access their specific technological and creative interests whether it be graphics, music, programming or whatever.

Some suggestions for how to implement these changes within the educational milieu need to be considered. There is a call for more workshops and working conferences both regionally and nationally to discuss gender and technology issues. Faculty development programs are essential. A project to develop course segments and course materials might also be useful. Also support is needed to integrate feminist research and perspectives on technology into the technology and the liberal

arts curriculum. (Rothschild,1988:79, Lewis,1987:277, Bateman,1985, Sealfon,1986, Women Computing,1983:5)

Problem with this new model

There is a major problem with this new paradigm that needs to be considered before it can be implemented: the question of ergonomics. It's all very well to talk of physically improving the educational environment by changing the arrangement of the computers - moving away from straight rows where students feel cut off and alienated - to more amenable groupings but how is this to be done? Computer systems, no matter how much they have decreased in overall size in the past few years, still occupy a fixed amount of space and they are not easily moved. Because of the very real concern about theft, the computer hardware is usually firmly bolted to the lab floor. The size of the computer lab, the entrances and exits from it, space taken up by windows, the lighting arrangements, extra equipment such as overhead projectors all have to be considered when appraising any changes to the physical layout of the space. Another factor that needs to be taken into consideration is the very real authority of the resident lab technicians. Lab technicians, almost exclusively male, preside over computer labs. They invariably have an entrenched territorial prerogative; this is their lab and students and teachers are considered outsiders: educators have access but no licence to make changes. To ask for changes at the software level which is just a matter of copying a programme onto the individual computer or network server often requires great diplomacy on the part of the

teacher; to make modifications at the hardware level is almost unthinkable for an instructor. This is where more power is needed at the level of the individual educator.

Future directions: whither the workplace?

If a paradigm of interconnectedness, cooperation and networks seems foreign to the Western workplace today, we might look at the direction that corporations and businesses are moving at the present time in theory and in practice.

Patricia Aburdene and John Naisbett have written a book *Re-inventing the Corporation* that outlines the shifts from the old industrial society to the new information society and their thesis is that there is a growing recognition that yesterday's hierarchical structures do not work in the new information society.

One of the most fundamental shifts they see is the movement away from the authoritarian hierarchy - where everyone has a superior and everyone has an inferior - to new lateral structures, lattices, networks, and small teams where people manage themselves. They envision the old bureaucratic layers as giving way to more natural arrangements in the new information society with a new set of patterns that encourages communication.

They question what will happen when the best of corporate talent has no corporate hierarchy to climb; what will happen to their competitive energy? One answer they propose is to transform it into a creative, enterprising spirit and channel it into small work groups where communication is quicker and more effective: networks, small teams, and other decentralized structures.

As the manager's role shifts to that of the teacher, mentor, and nurturer of human potential, they see this as even more reason for corporations to take advantage of women's managerial abilities because these people-oriented traits are the ones women are socialized to possess. Men and women could learn from one another without abandoning successful traits they already possess. Men can learn to be more collaborative and intuitive, yet remain result oriented. Women need not give up being nurturing in order to learn to be comfortable with power and conflict. The new corporation would be a place where intuition is respected and where the leader's role is that of facilitator, teacher and nurturer of human potential. That means that women could transform the workplace by expressing, not giving up personal values. They see women as moving to the center of the new work force and the old, adversarial relationship that existed between unions and management as being replaced with win/win arrangements, such as job sharing, wellness programs, and flexible benefit plans.

This would lead to an interconnectedness between the corporation and the other aspects of life - education, health, the family, and the community which would mean a company could not sit back and complain about the poor school system, about the women's movement making it harder to transfer people, about the high cost of employee health bills. Corporations would have to act on the basis of the interconnectedness between people and profit. That is better than social responsibility. It would mean that the corporate interests of people and communities would increasingly be the same. (Naisbett & Aburdene, 1985:30,207-254)

Naisbett and Aburdene's vision is a predictive hypothesis but is it just based on a utopian view? The following two excerpts are from a computer journal, *P/C Computing*, not particularly noted for an emphasis on social responsibility. The writers are Gareth Morgan, a professor of management at Toronto's York University, Wayne Tebb, a management consultant specializing in organizational change and new technology and Dr. Ralph H. Kilman, a professor of business administration and the director of the Program in Corporate Culture at the Katz Graduate School of Business, University of Pittsburgh. These management people use terms like 'holistic' and the web/network metaphors to describe the need for communication and interconnection as the new paradigm in the evolving workplace - a workplace connected by and connecting people and computers.

Morgan and Tebb envision that information-intensive environments call for a weblike alternative to the traditional pyramid - a network which favours the ability to make a contribution to the task at hand, no matter what a worker's title. As the distributed web of the network becomes the symbol of corporate organization in the information age, abilities that promote open-ended communication would increase in visibility and importance. They see re-orienting and repositioning one's activities creatively and autonomously, yet in concert with others, as requiring a holistic understanding of the organization's unifying pattern. This sense of interconnection and the ability of members to see themselves as parts of an evolving, open-ended pattern would be crucial factors in management competency in the PC environment. (Morgan & Tebb, 1989:106-110)

Kilman suggests that a new paradigm which he calls 'the network organization' is gradually taking shape. Some companies have already adopted parts of it, but no one company has yet incorporated it all. What it consists of is an interpersonal and electronic network of people, information and influence. The nucleus, or hub, of the organization is connected primarily (but not exclusively) through inter-personal relations among team members, while interorganizational and international relations are connected electronically, generally via PC-to-PC communications or fax transmissions - again a holistic system of coordinated action. Making these ingredients work together places increasing demands on interpersonal skills such as trust building, collaborating, communicating, deal making, and negotiating, as well as on information management skills such as using new technology: searching out, processing, and analyzing information; and integrating data files. (Kilman, November 1989:128-133)

American manufacturing companies were recently (July 1989) evaluated in eight categories, including pay and benefits; stability and job security; commitment to producing safe, high quality products; location and climate, quality and supervision; continuing education and encouraged personnel development; ambience and overall working conditions; and job challenges and rewards. Interestingly, four of the top ten companies were computer manufacturers; Apple, IBM, Hewlett-Packard and Digital Equipment were among the companies that share a similar employee philosophy. This philosophy is one of treating their employees, first and foremost, as unique individuals where they are expected to participate and contribute and are given the intellectual and personal freedom to do so. (New York(AP),1989)

What about Japan and its renown leadership in the industrialized world built on its massive economic development? Even there the philosophy appears to be changing. A report issued by the influential Ministry of International Trade and Industry (MITI) in July 1990, titled "International Trade and Industrial Policy in the 1990s: Toward Creating Human Values in the Global Age" offers three main goals for Japanese industry in the decade ahead. These goals are: to contribute to international society and promote internal reforms; to improve the quality of life for the Japanese people; to secure the foundations for long-term economic growth.

The report suggests that the ministry is expanding its horizons to include areas well beyond factory, laboratory and office walls. MITI defines its latest vision as responding to "new industrial areas and fields that go beyond traditional business boundaries, such as child care, housekeeping services, improved housing for the elderly and job opportunities for women." (Hughes,1990)

Summary

In this chapter I have shown how attitudes in the workplace are changing. Some companies are aware that a new operational structure is needed and that a network of cooperation, responsibility and caring might be the keys to its success. A different educational pedagogy that uses these values and takes into account different learning styles to teach women about computers could be constructed. I think that creating a computer education format based on Gilligan's care ethic would enable educators to change to a pedagogy that includes and empowers women.

Chapter VII

Conclusion

Women are not equal participants and do not have equal power in the hierarchally organised industrial workplace and they will not automatically become equal partners in the new information workplace that is based on computers. The problems women are facing with computers now are similar to those they encounter and have encountered in science and technology. The science/technology/computer continuum carries a heavy male bias that has been exclusive and elitist, not only to women but to those of different races and classes as well. We should be questioning the philosophies that guide science and technology and working to change them to ensure that everyone benefits.

Equal access to computer education for males and females has not empowered women for several reasons. Tying computer education to mathematical competence might be keeping out many unnecessarily when not all computing relies on skill in mathematics. Attitudes held by and about women may also affect the way women learn. Studies have shown that females may learn differently than males and while they are just as capable of learning, many females may have different learning styles than those of their instructors. Educators well versed in computer skills have probably

learned in traditional ways and often have a science/math background. They expect to teach in the same way they learned. Any change that empowers women requires a rethinking of the pedagogy employed by educators.

I propose the adoption of the conceptual framework described by Carol Gilligan as the paradigm for the new workplace - one based on caring, responsibility to the individual, networking and cooperation, and integrating it through education *about* computers and education *using* computers into the workplace. This would offer solutions to two problems at the same time: it would give a new and needed operational structure to the information workplace that would benefit all workers and it would give recognition and validity to women's values thereby enhancing women's position and esteem in society and the workplace. There would be two beneficiaries - women and work.

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Appendix A

A bibliography of research on Gilligan's framework

As moral theory

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Sichel Betty A. (1985) "Woman's Moral Development in Search of Philosophical Assumptions"

Socoski, Patrick M. (1984) "Responses to Sex-Bias Criticism in Cognitive Moral Theory"

West, John D.; Bursor, Davele E. (1984) "Gilligan and Kohlberg: Gender Issue in Moral Development"

In the field

Davis, Liane V. (1985) "Female and Male Voices in Social Work." *Social Work*; v30 n2 p106-13 Mar/Apr 1985

This study draws on Gilligan's work, analyses the rift between clinical social work practitioners and academicians and researchers in terms of gender. She argues that the female voice has been suppressed by the prevailing male model of knowledge development in the university and the distrust women have in their own voice.

Delworth, Ursula; Seeman, David (1984) "The Ethics of Care: Implications of Gilligan for the Student Services Profession." *Journal of College Student Personnel*; v25 n6 p489-92 November 1984

Delworth and Seeman discuss Carol Gilligan's perspectives on the differences in male and female development in terms of implications for student services professionals. They present several examples and related questions.

Lister, Judith G. (1986) "Work and Family: A Study of Employed Women and the Care of Their Infants."

This exploratory study was made of nineteen women who were gainfully employed while parenting their first infants who were enrolled in two day care centres providing excellent care. Emphasis was placed on understanding variations in mothers' perceptions of choices and conflicts associated with the dual role of worker and parent. Interview questions elicited information from mothers concerning considerations, choices, conflicts, and feelings associated with the dual role. Raters categorized mothers' responses according to stages of moral development proposed by Gilligan (1982). Analysis addressed commonalities and differences among the respondents. Findings suggested that participants could be grouped according to the orientations suggested by Gilligan's paradigm of moral development. Similarities seemed to exist in the reports of conflicts related to the dual role provided by women at different developmental stages. They consistently placed emphasis on the need for high quality day care. Differences were found in mothers' preferences for employment arrangements. The extent to which respondents felt that they had choices about their employment arrangements appeared to be related to feelings of conflict in their dual roles.

Rhodes, Margaret L. (1985) "Gilligan's Theory of Moral Development as Applied to Social Work." *Social Work* v30 n2 p101-05 Mar/Apr 1985

Rhodes discusses two modes of thinking about ethics developed by Carol Gilligan. She argues that Gilligan's modes of thought (responsibility and rights) correspond to two ideals of social work practice: a rights perspective, based on liberal individualism, and a needs perspective, based on nineteenth century Christian virtue.

Scott, Kathryn P.(1986) "Gender and Moral Education." Paper presented at the Annual Meeting of the National Council for the Social Studies (New York, NY, November 14, 1986).

Four areas of Kohlberg's theory relevant to the gender issue are critiqued, and work by Carol Gilligan, suggesting alternative theories for thinking and behaviour, is analyzed, compared, and contrasted. Historically when developing curriculum, educators have emphasized modes of thinking which are linked with masculine ideals, in a manner compatible with Kohlberg's theory of moral development. However, applications of Gilligan's model of moral development need to be developed and applied. Specifically a model of moral development that encompasses a broader view and one that includes the feminine voice is needed. A model of decision making that could be used for curricular planning contains the following components: moral sensitivity, moral judgment, moral decision making, and moral action.

Stonewater, Barbara Bradley (1987) "Career Traits, Decision Style, and Gilligan: Implications for Counselling Women." *Journal of the National Association of Women Deans, Administrators, and Counsellors*; v50 n2 p17-26 Winter 1987

This study explores gender differences in two career-related areas, traits, or personality, and decision-making style - and interpreted findings in light of Gilligan's developmental theory. It indicates that women in the sample had a greater tendency to be Social or Conventional Holland types, and External decision makers on the Johnson Decision Making Inventory.

Appendix B

A list of bibliographies on research on women and science

compiled by Londa Schiebinger, in "The History and Philosophy of Women in Science: A Review Essay" in *Signs: Journal of Women in Culture and Society*, University of Chicago Press, Volume 12, Number 1, Autumn 1986)

Aldrich, Michele, "Review Essay: Women in Science," *Signs: Journal of Women in Culture and Society* 4, no 1, 1978, 126-35

Chinn, Phyllis Zweig, *Women in Science and Mathematics: Bibliography*, Arcata, California, Humboldt State University, 1980

Davis, Audrey B., *Bibliography on Women: With Special Emphasis on Their Roles in Science and Society*, New York, Science History Publications, 1974

Hubbard, Ruth, Mary Sue Henifin, and Barbara Fried, eds., *Biological Women - the Convenient Myth: A Collection of Feminist Essays and a Comprehensive Bibliography*, Cambridge, Mass., Schenkman Publishing Co., 1982

Siegal, Patricia and Kay Finley, *Women in the Scientific Search: An American Bibliography*, Metuchen, N.J, Scarecrow Press, 1985, 1724-1979