GENDER CODES

Why Women Are Leaving Computing

Edited by THOMAS J. MISA

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Gender Codes

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In memory of Karen J. Freeze (1945–2009), scholar and colleague, who in her life successfully bridged notable divides between nature and culture, industry and academe, research and family, and East and West.

Foreword

In 1966 there was already a “manpower” shortage of trained (or even untrained) programmers, operators, and software designers. The situation became a crisis when an estimated 50% more programmers would be needed by 1967.

It was an exciting time—the Mercury and Gemini programs sent humans into space and the Apollo program landed them on the Moon and returned them safely to Earth. The effort fulfilled President Kennedy’s goal when he said that “no single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish.”

With this kind of presidential mandate, there were free-flowing funds in collecting the workers, and there were no barriers to race, religion, political leanings, or gender. Just about anyone who could pass an aptitude test, believed in the mission, and loved challenges in logical thinking was brought on board. The work was centered around the computers and the control systems that launched astronauts into space, and not on ambition or power—it was amazing that so many people could be coordinated and committed so that each person felt he/she had a part in the work. That gave us all a sense of pride.

I was lucky enough to join the ranks in 1965, when the National Aeronautics and Space Administration (NASA) and its subcontractors were hiring a cast of thousands. The desperate need was primarily a call to arms due to the Cold War and the race for space—using a new technology only increased the challenge!

Of course, we must admit that there were hurdles as well as successes. Sadly, the struggles have not always been brought to light, nor have they resulted in learning experiences. Where I worked in 1965, men and women programmers and program designers sat together in offices (pre-cubicle), shared ideas, and acted as sounding boards for each other. We had comfortable and equal working conditions, supplies, and equipment. Following a design, we wrote—by hand—computer program instructions on large coding pads (80 columns per instruction, the same width as a Hollerith punched card). A courier came by twice each day, picking up the coding pads and delivering yesterday's instructions that had been magically translated into a different physical medium—card decks. Put some paper on a cart one day and presto, the next day, a stack of $7\frac{3}{8}$ inch by $3\frac{1}{4}$ inch, stiff paper sheets with holes punched in them were delivered. These cards constituted the program, which was sent to the machine room where operators fed the decks through the card reader. (Remember, this was the mid-1960s.)

What I did not think about then was that the machine room, where the programs ended their journey, was cool (it had to be—the older mainframe computers put out a lot of heat), the operators had some authority, and they were male. By contrast, the "support" room in the basement housed the female keypunchers. It was hot and stuffy and filled with rows and rows of machines where the women sat in front of the card punch machines all day. Keypunching was mind-numbing, the breaks were seldom and short, and the data had no meaning to the keyboardists. (This is not to denigrate the job or the need for it—members of my close family were keypunch "girls.")

Unfortunately, these women were often blamed for errors in the deck, which then became errors in the program—it was easy for a programmer, any programmer, to shift the

blame when necessary. This resulted in instituting a verification procedure where each punched card deck had to be rekeyed, using the exact same data, by another woman, making the reward system (based on volume) even less meaningful.

During this time period, I knew several male operators who, without a 4-year degree of any kind, were promoted into the ranks of programmer, seemingly because they were skillful at reading hardware signal lights, fanning card decks, hanging tapes, mounting disks, or even just putting printed output on delivery carts. These were important, necessary activities, carried out by some incredible young men. However, it isn't at all clear how those duties translated into a talent for programming. Keypunchers, who also performed mostly physical tasks, were rarely (never, in my experience) selected for aptitude tests or invited to an interview that could have led to an elevated position. I never knew of a single woman keypuncher who was promoted into any other rank, with the possible exception of women who were elevated to group supervisor, and then they had to stay in the same hot room. I wish I were relating only an individual experience and not the norm, but there is evidence that this situation was prevalent and has been recreated in many ways.

In 1969, the Data Processing Management Association (DPMA) awarded its very first "Computer Sciences Man of the Year" award to U.S. Navy Commander Grace Hopper, eventually to be Rear Admiral Hopper. She was already famous as the "inventor" of COBOL, a programming language that was close to natural speech (English)—for many years the most widely used language in computing. On three different occasions I drove for hours just to hear her captivating and motivating speech. Now she was a role model.

Women continued to enter the field of computing, not only as “keypunch girls” but also as professionals and educators who could employ their mathematical or engineering education or proclivities, in unprecedented numbers during the 1960s and 1970s. Many, maybe most, of them greatly enjoyed their experiences.

There were the pros and cons of being female in the computing field then, just as there are now. The disadvantages still exist, but they have morphed into different ones and are shifting the workforce culture in an unhealthy direction that threatens the future of a profession that still needs diverse participation and input to support our undisputed computer-reliant life.

In this book, the chapters provide a fresh and constructive look at potential reasons for the growing imbalance in gender, exploring the different reasons for the evolution of a profession that has become as male coded as the computing profession now is. While the first wave of programmers and analysts worked in a relatively unsegregated environment, the current computer workforce (across all sectors, including government employees, small business owners, entrepreneurs, chip designers, space-race programmers, and game developers) has become ordered and structured as primarily male.

While Thomas Misa and his colleagues search for answers, they assume no conspiracy theories. There is no diatribe against the male gender, nor does anyone fan the flames of the early feminist movement. It is simply a fact that the last 25 years have seen an increasing imbalance in gender in the computing profession. Most other science and technology sectors actually demonstrate steady growth in the number of female participants. Clearly, something odd happened in computing.

This book is, at times, brutally honest: women are practically absent from the historical literature on

computing. They made significant contributions in all segments of the computer industry, yet they had to fight for respect and funding, and too often they lost.

This book gives voice to historians as well as practitioners—those who experienced the heyday, those who are trying to understand it, those who report it, and all those who are trying to change it. The book takes a fair look at this complex issue, is true to history, presents an international perspective, and without judgment explores the strange and unsettling phenomenon that we are now living with: only the male half of the population is working to achieve the potential of computing. And, with the diagnosis that computing's public image is radically out of step with computing's actual practices, the book presents a clear way of moving forward.

If I had had a crystal ball in 1965 and realized what 2009 would look like, it might have been easier, or more obviously important, that we should strive to preserve the culture of the "golden age" of women in computing, while helping it to mature and evolve to meet today's technical challenges. And, by all measures, to be fair.

LINDA SHAFER, CSDP

IEEE Computer Society Press Chair

Preface

We don’t normally think of academic publishing as a contact sport, but this volume was born with bruises on my arm. We were planning a workshop at the Charles Babbage Institute (CBI) and enjoying the process of framing a much-needed historical assessment of gender and computing. We knew it was a respectable topic. Scholars from many different backgrounds and traditions had in recent years put gender on the academic map. The exploration of gender and computing history was long overdue. After all, there must be something in the many hundreds of photographs we’d seen over the years showing “white guys with computers.”

When introducing the CBI workshop to my colleagues in science and engineering, I explained how gender had become a useful category of analysis in the social sciences, and our aim for bringing gender analysis into the mainstream of computing history. Often, I didn’t get more than two or three sentences into the spiel when a female colleague grabbed my arm and said: “no, you don’t quite understand—what you are doing, gender and computing, is important, really important.” My technical colleagues had gone through graduate school and started their careers in the midst of the women’s movement, and many had struggled in their careers and institutions with its ambiguous successes. They wanted to *understand* gender and computing, but they also wanted to *change* the existing state of affairs. This volume took form with both these aims in mind.

We were fortunate to draw on a growing interest in the gendered aspects of computing. Educators, administrators, managers, and scholars share an interest in better understanding how computing has emerged and become part of contemporary culture. Computing educators are justifiably concerned about flagging computer science and engineering enrollments, while administrators and

managers at all levels strive to recruit and retain a more gender-balanced workforce. Scholars in computer history can appreciate that gender is a useful category of analysis, and that gender studies of computing are urgently needed. To identify promising themes and possible contributors, we formed a steering committee consisting of Janet Abbate (Virginia Tech), Veronika Oechtering (University of Bremen), Jeffrey Yost (Charles Babbage Institute), and myself.

Bringing these educators and scholars together for a weekend in May 2008 depended on material support from several sources. At the University of Minnesota, we are grateful for essential financial support from the Institute of Technology Dean's Office, the Computer Science and Engineering Department, the Electrical and Computer Engineering Department, and the Program for the History of Science, Technology and Medicine. International travel was funded by the University's Office of International Programs and the Deutsche Forschungsgemeinschaft (German Research Foundation). Everything we do at the Charles Babbage Institute represents a unique partnership between the founders of CBI, with their prescient vision of supporting a research center for the history of computing, and the longstanding institutional support from the University of Minnesota's Institute of Technology, the University Libraries, and the Program for History of Science, Technology and Medicine.

We are fortunate also for first-rate staff at CBI. R. Arvid Nelson, CBI's archivist, developed a special museum exhibit entitled "Gendered Bits: Identities, Practices, and Artifacts in Computing" in cooperation with in-house professional designer Darren Terpstra. These materials were physically installed in Andersen Library during the summer of 2008 and will be made available permanently via an online exhibit. (Images of the installed exhibit, as well as literature and background materials for the workshop, can be found at

umn.edu/ ~tmisa/gender/.) Katie Charlet took charge of registration and played an essential role in preparing this volume for publication, including translations from the French (again!), while Jeffrey Yost and Stephanie Crowe assisted with preparations and logistics.

Gender studies of technology and science have an active interdisciplinary journal literature in *Signs*, *Women's Studies*, *Gender and Society*, and *Social Studies of Science*, *Technology & Culture*, as well as key books, including those by Roger Horowitz (editor), *Boys and Their Toys?* (New York: Routledge, 2001); Donna J. Haraway, *Simians, Cyborgs and Women* (New York: Routledge, 1991); Donna J. Haraway, *Modest_Witness@Second_Millennium* (New York: Routledge, 1997); Nina E. Lerman, Ruth Oldenziel, and Arwen Mohun (editors), *Gender and Technology* (Baltimore: Johns Hopkins University Press, 2003); Ruth Oldenziel, *Making Technology Masculine* (Amsterdam: Amsterdam University Press, 2004); and Roger Horowitz and Arwen Mohun (editors), *His and Hers* (Charlottesville: University of Virginia Press, 1998). For computer history, see the special issue introduced by Janet Abbate, "Women and Gender in the History of Computing," *IEEE Annals of the History of Computing*, Vol. 25, No. 4 (2003): 4–8. Our gender and computing bibliography can be found at www.umn.edu/~tmisa/gender/literature.html.

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Minneapolis, Minnesota

March 2010

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CORINNA SCHLOMBS in December 2009 completed her dissertation, a comparative and transnational examination of the transfer of computing technology and culture between the United States and Western European countries from the end of World War II to the late 1960s, in the History and Sociology of Science Department at the University of Pennsylvania. She has published "Toward International Computing History," in *IEEE Annals of the History of Computing*, Vol. 28, No. 1 (2006): 107–108; and "Engineering International Expansion: IBM and Remington Rand in European Computer Markets," in *IEEE Annals of the History of Computing*, Vol. 30 (2008): 42–58.

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Part I: Tools for Understanding
1

Gender Codes

Defining the Problem

THOMAS J. MISA

Women have passionately programmed computers for many decades. Ada Lovelace wrote abstract programs for calculating Bernoulli numbers on Charles Babbage's mechanical computer, and six women mathematicians, known as human "computers," created working programs for the ENIAC computer during the Second World War. In the 1950s the pioneering generation of computer science featured a surprising number of prominent women who led research teams, defined computer languages, and even pioneered the history of computing. The annual Grace Hopper celebration, named for the most prominent of these pioneering women computer scientists, offers "a four-day technical conference designed to bring the research and career interests of women in computing to the forefront"[1]. More recently, Elizabeth "Jake" Feinler defined the top-level domain names—.com, .gov, .org—for the Internet. In 2006, Fran Allen, already the first female IBM Fellow, was the first woman to win the prestigious Turing Award from the Association for Computing Machinery, for her work in

optimizing computer code. Two years later, Barbara Liskov was awarded the Turing Award for her foundational work on programming languages. The list of notable women in computing is sizable and expanding. It's strange anyone would think that women don't like computing.

Since the 1970s women have made impressive gains in professional life, but these gains did not extend evenly into the fields of engineering and the physical sciences. Greater gender parity has typified most professions in the past two decades or so, with women making up half or more of all graduate or professional students: this is true for law schools and medical schools as well as most fields in the social and biological sciences. Engineering and physical sciences started with rather few women, at all levels, and have been making slow if steady progress in enrolling more women students and hiring more women faculty and scientists. Retaining women scientists and engineers at mid-career remains a challenge. But when you look at the college enrollments and workforce figures for computing, a strikingly different picture emerges.

There's no way of putting it except to say that computing is unique among all the professional fields. You can see this most clearly when looking at the "big picture" across the last 40 years and identifying which of the technical professions women opted to enter and when they did so. The first distinction for computing was an early upside in women's participation. Beginning in the mid-1960s, women entered the emerging computing profession and eventually did so in unusually large numbers (Fig. 1.1). In the United States, women went from being roughly one in ten in the undergraduate computing cohort to being nearly four in ten. At the peak in the mid-1980s women earned 37% of all U.S. bachelor degrees in computing, and across these decades women entered the computing workforce in large numbers. In the late 1980s, women constituted fully 38% of the U.S.

white-collar computing workforce. This was a significant success for computing and for the women's movement. Chapters in this volume describe why, for roughly two decades, computing attracted so many women.

Figure 1.1. Woman studying linear programming. For recruiting, Honeywell created a positive image of women programmers in 1969. Women, such as Christine Johnson, composed one-third of the opening class of 40 at Honeywell's Wellesley Hills, Massachusetts, education center. (Courtesy of Charles Babbage Institute.)

We need to better understand why women elected to study *computing* in such large numbers. Why not chemistry or physics or engineering or one of the other technical professions? Men through the 1960s soundly dominated all of these fields. In this book we explore why large numbers of women experienced programming and other computer-related jobs to be more congenial than working in science labs or in engineering offices. We show that women worked as programmers, as systems analysts, as managers, and as computer executives. In the mid-1980s, while women flooded into computing education and from there into the computing workforce, there were proportionately more