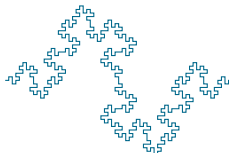# A Historical Examination of the Social Factors Affecting Female Participation in Computing
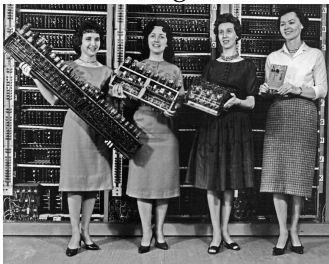
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INTRODUCTION

- ▶ How did we go from this...

- ▶ To this?

APPROACH

- ▶ Literature review
  - ▶ 73 papers
  - ▶ 5 books
  - ▶ 2 PhD theses
  - ▶ Computing Educators Oral History Project
- ▶ Mix of sources:
  - ▶ History of computing (mostly focuses on tech, 30s-60s)
  - ▶ History of women in STEM (mostly focuses on natural sci)
  - ▶ Papers on women in CS, used as primary sources

CAVEATS

- North America only
    - Disprop. amount of sources focus on R1s
    - White people
- Big Picture
    - Your experiences may vary!
    - I'd love to hear your stories after the talk

19TH CENTURY

- ▶ Early 19th century: rise of women's colleges to "produce better wives and mothers" – Margaret W Rossiter, *Women scientists in America: Struggles and strategies to 1940*, vol. 1 (JHU Press, 1982)

- ▶ First Wave Feminism – ibid.

- ▶ Women of privilege – ibid.

- ▶ 1870-1900: women PhDs at traditional universities – ibid.

- ▶ Few job opportunities for women after graduation: – ibid.
    - ▶ teaching
    - ▶ computer

- ▶ Marriage meant end of career – ibid.

- ▶ Their work has been systematically undervalued –
    Margaret W Rossiter, "The Matilda effect in science," *Soc. studies of sci.* 23, no. 2 (1993): 325–341

"WOMEN'S WORK"

- ▶ 20s and 30s: scope of "women's work" increased, World Wars – Rossiter, *Women scientists in America: Struggles and strategies to 1940*
- ▶ Women were stereotyped as being better coders – J Currie Little, "The role of women in the history of computing," in *Tech. & Soc.* (IEEE, 1999), 202–205
- ▶ Quantitative work considered "women's work" until the 30s-50s – Kristin Luker, *Salsa dancing into the social sciences: Research in an age of info-glut* (HUP, 2008)

EARLY CODERS

- Early computing done by women; plan was for female 'coder' working under male scientist – Nathan Ensmenger, *The computer boys take over: Computers, programmers, and the politics of technical expertise* (MIT Press, 2010)

- Became male typed over time – ibid.

- 50s and 60s: programing as a 'dark art' – beginning of asocial stereotype – ibid.

- Lazy hiring practices in the 50s/60s hurt female participation in IT – ibid.

- Women in the 50s: had to leave jobs upon pregnancy – Gloria Reinish, "A woman engineer's view of 50 years in the profession," in *Tech. & Soc.* (IEEE, 1999), 219–222

EARLY COMPUTER SCIENCE

▶ 50s/60s: CS conducted through other departments –

Scott M Campbell, *The Premise of Computer Science: Establishing Modern Computing at the University of Toronto*

(1945–1964). (U. of Toronto, 2006)

▶ 60s/70s: first CS degree programmes – ibid.

▶ Undergrads: around 15% women in 1970 – Catherine Ashcraft,

Elizabeth Eger, and Michelle Friend, *Girls in IT: The Facts*, 2012

▶ Diverse backgrounds: math, engineering, psych,
  linguistics, music, etc – Denise Gürer, "Pioneering women in computer science," *ACM*

SIGCSE Bulletin 34, no. 2 (2002): 175–180

CS AND SCIENCE

- Women in CS in the 60s/70s: similar experiences as women in the other sciences – Henry Etzkowitz et al., "The paradox of critical mass for women in science," *Science* (1994): 51–51

- Through the 70s, female enrolments were on par with physics, growing in lockstep from around 15% to 20% – Ashcraft, Eger, and Friend, *Girls in IT: The Facts*

INTRO.   HIST. OF WOMEN IN SCIENCE   **HIST. OF CS ENROLMENTS**   ACADEMIC GENERATIONS   DISCUSSION   BIBLIOG.

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THE FIRST BUBBLE: THE 80S

- ▶ High enrolments in the 80s led to stricter requirements for CS majors, retooling of CS1 as a weeder course – Eric S Roberts, Marina Kassianidou, and Lilly Irani, "Encouraging women in computer science," *ACM SIGCSE Bulletin* 34, no. 2 (2002): 84–88

- ▶ Led to fewer 'non-traditional' CS students, esp. women – ibid.

- ▶ Men running the show; no consideration of how decisions like this could affect diversity – Jane Margolis and Allan Fisher, *Unlocking the clubhouse: Women in computing* (MIT press, 2003)

THE 90S

- The rise of video games and "hacker culture" in the 90s compounded the decrease – Tracy Camp and D Gurer, "Women in computer science: where have we been and where are we going?," in *Tech. & Soc.* (IEEE, 1999), 242–244

- Serious organization of women's groups in CS, e.g.
  - 1987: Anita Borg Institute – Anita Borg Institute, *About Us*
  - 1991: CRA-W – CRA-W, *About CRA-W*
  - 1994: Grace Hopper Celebration – Currie Little, "The role of women in the history of computing"

ENROLMENTS KEPT CYCLING

- ▶ Dot-com bubble
  - ▶ Total enrolments increased – Jay Vegso, "CRA Taulbee Trends: female students & faculty," *Computing Research Association* 6 (2004)
  - ▶ % of women increased (peak: 30%) – ibid.
- ▶ Dot-com bust
  - ▶ Spree of faculty hiring, increasing the % of female profs – Jacob Slonim, Sam Scully, and Michael McAllister, *Outlook on Enrolments in CS in Canadian Universities* (Info. / Commu. Tech. Council, 2008)
  - ▶ Again, restrictions – ibid.
  - ▶ % of women decreased disproportionately (down to 15%) – Vegso, "CRA Taulbee Trends: female students & faculty"; J. McGrath Cohoon, "Recruiting and retaining women in undergraduate computing majors," *SIGCSE Bull.* (New York, NY, USA) 34, no. 2 (June 2002): 48–52

RESEARCH ON WOMEN IN CS

► 00s: start of more rigorous research on women in CS –

  Ken Yasuhara, "Viewpoints from the doorstep: Pre-major interest in and perceptions of computer science"

  (PhD thesis, University of Washington, 2008)

► Unlocking the Clubhouse: a first success story at CMU
  ► They redid enrolment controls – Margolis and Fisher, *Unlocking the clubhouse:*
    Women in computing
  ► And retooled CS1: multiple entry points, not weeding – ibid.
  ► And engaged faculty to talk about research, not "hacking" –
    ibid.
  ► Women in BSc: 7% to 40%, from 1995 to 2000 – ibid.

INTRO.   HIST. OF WOMEN IN SCIENCE   HIST. OF CS ENROLMENTS   **ACADEMIC GENERATIONS**   DISCUSSION   BIBLIOG.

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GENERATIONS OF WOMEN IN STEM

- ▶ Framework by Etzkowitz et al: "generations" of female students in science – Etzkowitz et al., "The paradox of critical mass for women in science"
    - ▶ Based on interviews of senior and junior scientists from five disciplines (incl CS) in the mid-90s
    - ▶ Comparing/contrasting the experiences of
        - ▶ the "first generation" (who entered in the 60s/70s) to
        - ▶ the "second generation" (who entered in the 80s/90s)
- ▶ "Third Generation": entered in 00s/10s – Marlene Zuk and

  Sheila O'Rourke, *Is Biology Just Another Pink-Collar Profession?*, 2012

- ▶ Generations not as clear in CS due to the cyclical enrolments

THE FIRST GENERATION

- *"The ones who did [science] were really tough cookies. Now it's easier to get in. At one time it wasn't even acceptable to start. So if you started back then you were tough to begin with."* – Etzkowitz et al., "The paradox of critical mass for women in science"

- Expected to behave like men; women worked in a culture which expected them to *"accept the strictures of a workplace organized on the assumption of a social and emotional support structure provided to the male scientist by an unpaid full-time housewife"* – ibid. .

- Family was secondary, if done at all – ibid.

- Encountered explicit sexism, harassment, discrimination – ibid.

SECOND GENERATION IN STEM

- ▶ In STEM: women who entered in 80s/90s – Etzkowitz et al., "The paradox of critical mass for women in science"

- ▶ Encountered less explicit sexism; had female classmates – ibid.

- ▶ These women in STEM wanted to be *women* too – ibid.

- ▶ Went to 1st Gen women for advice on starting families, etc
  – *Computing Educators Oral History Project*

  - ▶ often 1st Gen women couldn't help – Etzkowitz et al., "The paradox of critical mass for women in science"

- ▶ "Neo-traditional" marriages: juggling science and disprop. amount of housework – Elaine Howard Ecklund et al., *Men's Changing Devotion to Work: How Male Scientists Navigate Competing Devotions to Work and Family*, 2012

- ▶ 1st Gen advisers were harsh on 2nd Gen students – Etzkowitz et al., "The paradox of critical mass for women in science"

- ▶ Different views about women-in-STEM initiatives – ibid.

SECOND GENERATION IN CS

- ▶ Not nicely defined for CS: different enrolment patterns
- ▶ Nerd stereotype more salient in 90s than 80s *– Computing Educators Oral History Project*
- ▶ Sub-generations based on boom/bust cycles?
  - ▶ Rise of the nerd stereotype
  - ▶ Video games
- ▶ Growing up: unequal access to computers *– Denise Gürer and Tracy Camp, "An ACM-W literature review on women in computing," SIGCSE Bull. (New York, NY, USA) 34, no. 2 (June 2002): 121–127*

THIRD GENERATION IN STEM

▶ Looking to the other sciences, starts in 00s – Zuk and O'Rourke, *Is Biology Just Another Pink-Collar Profession?*

▶ As girls they outperformed boys in school – Melanie C Steffens and Petra Jelenec, "Separating implicit gender stereotypes regarding math and language: Implicit ability stereotypes are self-serving for boys and men, but not for girls and women," *Sex Roles* 64, **numbers** 5-6 (2011): 324–335

▶ These women enter with female classmates, profs – Etzkowitz et al., "The paradox of critical mass for women in science"

▶ Much larger % of these women share parenting duties equally with spouses – Ecklund et al., *Men's Changing Devotion to Work: How Male Scientists Navigate Competing Devotions to Work and Family*

▶ Don't always identify with the Second Generation women
– Zuk and O'Rourke, *Is Biology Just Another Pink-Collar Profession?*

THIRD GENERATION IN CS

- ► Unclear for CS when the "Third Generation" starts
- ► Regardless, the experience of women who entered in the 00s/10s is qualitatively different – Lenore Blum and Carol Frieze, "The evolving culture of computing: Similarity is the difference," *Frontiers: A J. of Women Studies* 26, no. 1 (2005): 110–125
- ► Existing support network for women in CS – Camp and Gurer, "Women in computer science: where have we been and where are we going?"
- ► Equality in technology usage – Elisheva F Gross, "Adolescent Internet use: What we expect, what teens report," *J. of App. Dev. Psych.* 25, no. 6 (2004): 633–649
- ► Yet stereotypes are more salient than ever – Sapna Cheryan et al., "The Stereotypical Computer Scientist: Gendered Media Representations as a Barrier to Inclusion for Women," *Sex roles* (2013): 1–14

PRACTICAL CONSIDERATIONS

- ▶ Consider the needs of incoming women: differing experiences by generation
  - ▶ Solicit suggestions on initiatives from young women
- ▶ Learn from history: Think carefully about how to handle increasing enrolments
  - ▶ Focus on "non-numerics" in applications for CS major
  - ▶ Focus on maintaining a welcoming CS1 environment
  - ▶ Create/maintain multiple routes into the CS major

ACKNOWLEDGMENTS

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