

Women in Science and Engineering

Silvia Sara Canetto, Ph.D.

Department of Psychology, Colorado State University, USA



L. Bassi 1722-1778



E. Strada 1884-1970



M. Stack 1922-2013



S. Cristoforetti 1977

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Saturday 9 Jul 2022, 17:25 - 17:50

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Women Are Underrepresented in Science and Engineering

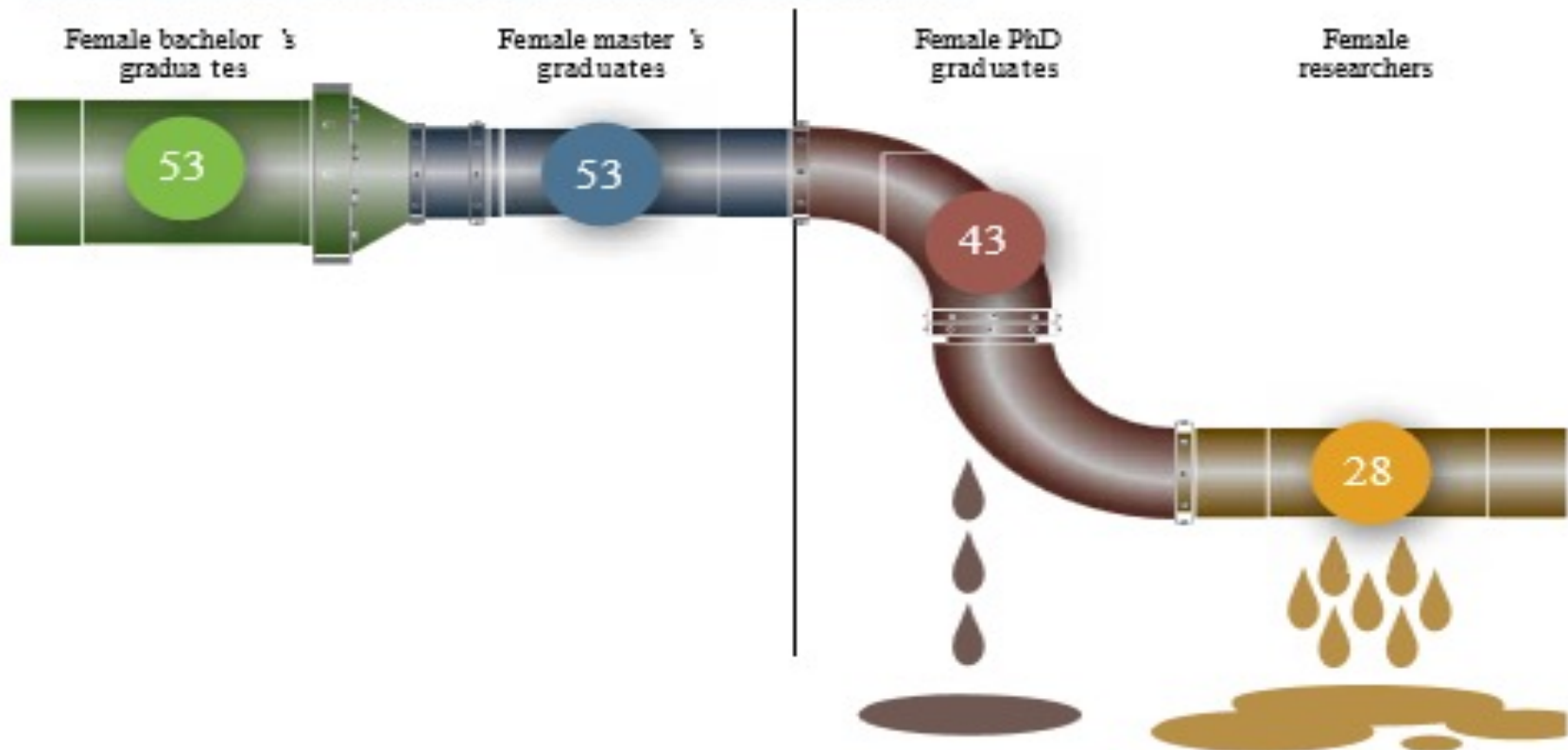
In the U.S., **women are underrepresented in science and engineering** (SE) education and occupations.

The higher the level of SE education, the fewer the women.

The higher the status of the SE occupation, the fewer the women.

The Leaky Pipeline Metaphor

The leaky pipeline: share of women in higher education and research, 2013 (%)



Source: UNESCO Institute for Statistics estimates based on data from its database, July 2015

The **Leaky Pipeline** to SE Academia in the U.S.

- Women earned about half of SE undergraduate degrees, 44% of master's degrees, and 41% of doctorate degrees but were only 38% of SE academic faculty in 2016 (NSF, 2019)

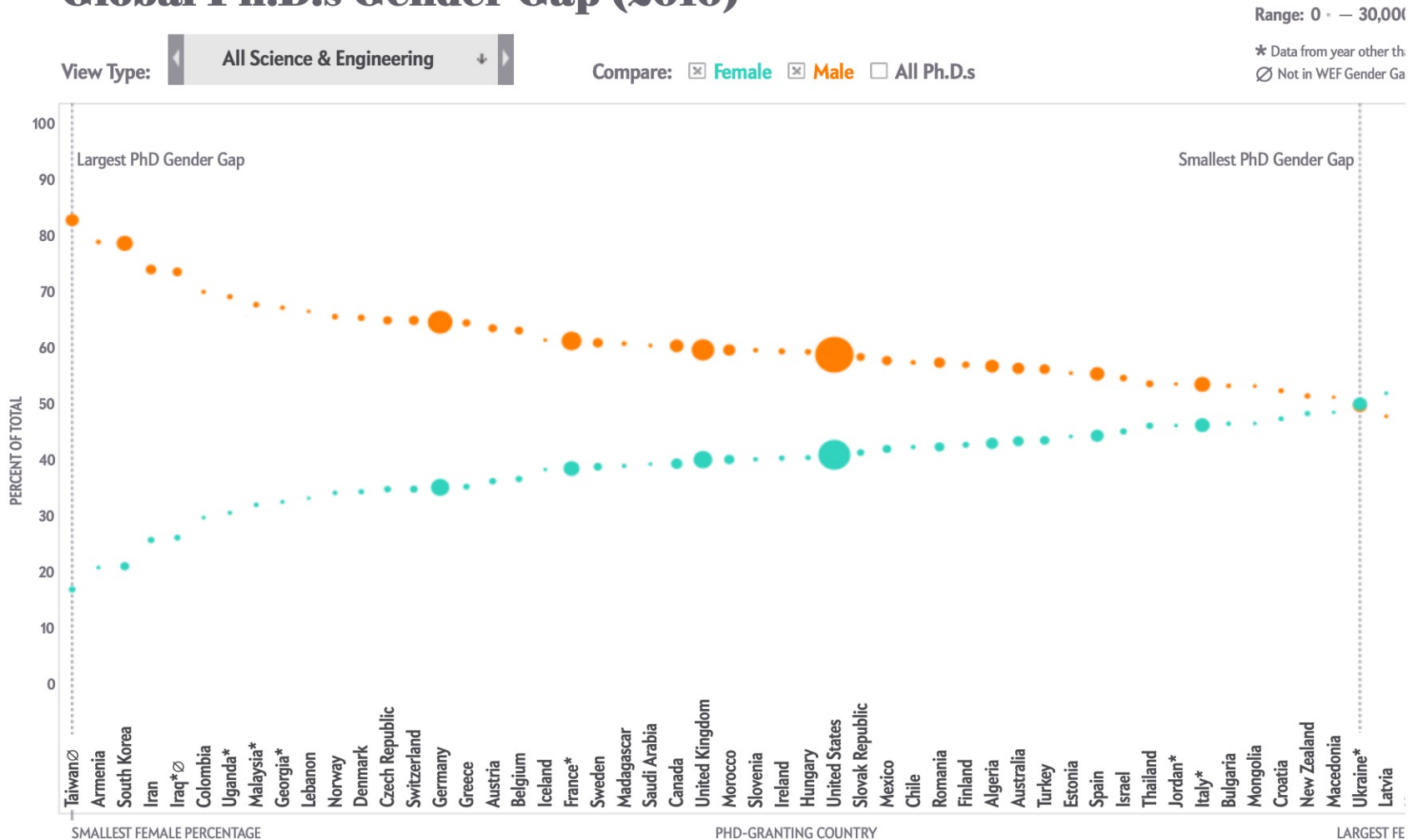
Why so Few SE Women?

It is Not a Math Skill Issue

- The women/men **gap in math performance** has **narrowed or disappeared** in recent decades. It also varies by country (Lindberg et al., 2010).
- Women's representation in math-intensive fields **varies by country, and within countries, over time.**
- Women's underrepresentation in SE is **not consistent across math-intensive fields.** Women have entered in large numbers in some math-intensive SE fields, but not others.

Percentage of Female and Male Science and Engineering Ph.D.s by Countries

Global Ph.D.s Gender Gap (2010)



Why so Few SE Women?

“Natural” “Feminine” Disinterest?

- In the U.S. women tend to express greater interest in educational paths and occupations focusing on people.
- In the U.S. women are under-represented in disciplines perceived as dealing with things/objects.

How Do Interests Develop?

- In the U.S. **women are socialized into, and rewarded for interest and engagement in people-skills' education and occupations.**
- In the U.S. **women are not socialized toward SE education and occupations.** In fact there are social costs to women expressing a preference for SE ("things") education/occupations.

Why so Few Women in SE?

A Discipline-Status Issue?

- Around the world **women are underrepresented in prestigious, non math fields**, such as philosophy and are well represented in fields locally defined as low-status. Around the world, women are underrepresented in non math fields assumed to require “**genius**”, such as music composition.
- In many countries women are underrepresented **in fields that are defined as intellectually “demanding.”**
- **The definition of low status and easy is culturally specific.**

Why so Few Women in SE?

Social-Service and Safety Issues?

- In many countries women are well represented in fields locally defined as **service-oriented**.
- In many countries women are well represented in fields locally defined as **safe**.
- **The definition of service-oriented and safe is culturally specific.**

A Cultural Lens on Women's Educational and Occupational Interests and Choices is Critical

- Cultural scripts of gender and SE theory
- In the U.S., as elsewhere, women and men tend to develop an interest in, and to choose the education and occupations that are defined as appropriate for them as women and men in their culture.

What Are Cultural Scripts of Gender and Science?

- The **beliefs, norms and practices about women and men** in science and engineering **of a culture**.
- **The who (i.e., women and/or men), which (i.e., which science), how (i.e., in what role), and why participate in science.**

Gender as

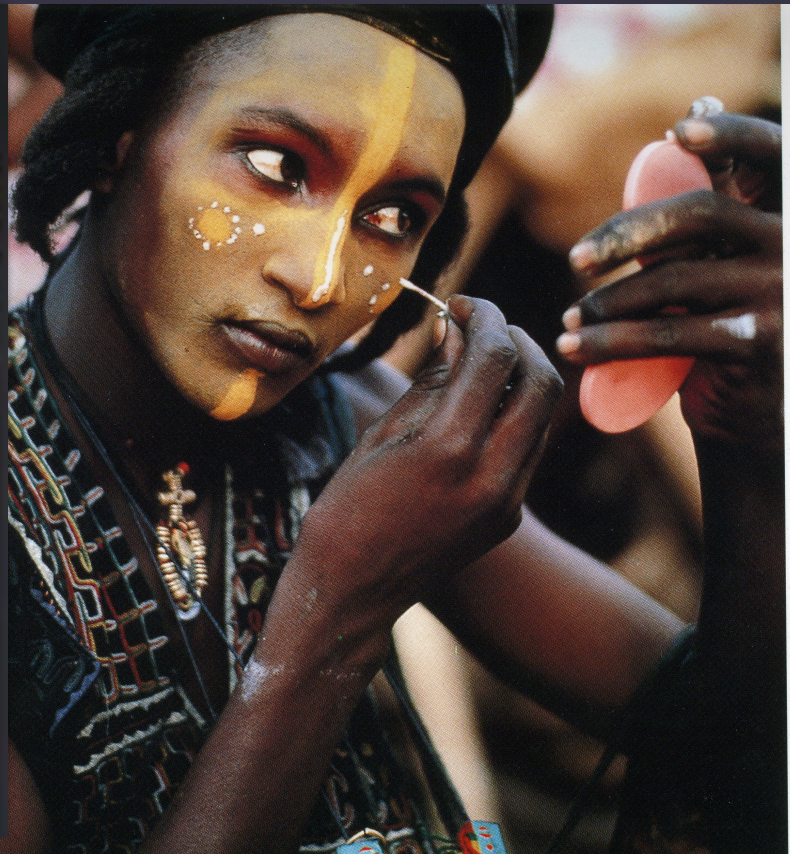
- **Cultural definitions of femininity and masculinity.**
- **A system of meanings about women and men in which we are all immersed, and which informs**
 - Expectations, norms, beliefs about women and men
 - Practices about women and men, as well as behaviors by women and men, based on norms
 - Roles/status/power of women and men in social structures (e.g., legal system) and institutions

Doing Gender

We do not have a gender. **We do gender**
(West & Zimmerman).

The way we do **gender is culturally
grounded and historically specific.**

Doing Femininity in the U.S. and Doing Masculinity in Niger



Doing Masculinity in Italy, Now and in the 1700s



Gender is about **Hierarchy**

- Gender **is a structure of society that encodes differential power relationships,** as does age.
- Societies assign **status, power, and privilege based on sex, creating gender.**

How to study Gender Scripts of Science?

- Methods: Structured/quantitative (e.g., structured surveys) and less structured/qualitative (e.g., interviews)
- Content: Studies of beliefs, attitudes, norms about gender and science
- Experiments
- Studies of narratives of gender and science (including via interviews)

My Research on Gender Scripts of SE

- My research focuses on the geosciences and engineering



My Research on Gender Scripts of SE

- Most of my studies examine the graduate student to early career stages
- A reason is that during **graduate school** career paths are evaluated and committed to. Also a doctorate is the passport for a SE research leadership career



Interest, Choice and Women's Underrepresentation in SE Leadership Positions

- An aim of my studies is to understand **interest** and **choice issues in women's underrepresentation**, especially in SE leadership positions
- In the U.S. and elsewhere **women are particularly underrepresented in SE leadership positions**, including in academia
- Graduate school is a critical time for making a commitment to a SE leadership position, and specifically to an academic career in SE.

Method

Participants:

Female and male SE graduate students from two major U.S. research universities (1 public, 1 private; one in the Mountain West, one in the North East)

Procedures:

- Participants were recruited via email invitation and via student and faculty referrals.
- They filled out a survey about their personal and educational background, their path to graduate school, and their professional as well as personal plans
- Some were also interviewed. The semi-structured interviews ($M = 90$ minutes) explored SE views, experiences, and professional plans.
- Interviews were audio-recorded, transcribed verbatim, and edited for accuracy.

Educational and Career Intentions of SE Women and Men

What are the educational and career intentions of female and male SE graduate students?

Does relationship/civil status matter in their educational and career Intentions, and if so how is having a partner/being married relate to the educational and career intentions of SE women versus men?

Selected Structured-Survey Findings: SE Educational & Career Intentions

- Female SE graduate students were **less likely** than male SE graduate students to express an **intent to complete a SE doctorate**.
- Female SE graduate students were **less likely** than male SE graduate students **to express an intent to pursue a SE career**.

Selected Structured-Survey Findings: Women's Personal and Professional Plans by Spouse Occupation

- Female SE graduate students with a husband in a science, technology, engineering or math (STEM) field expressed *less intent* to pursue a SE doctorate or an *academic career* than female SE graduate students with non-STEM husbands.

Selected Structured-Survey Findings: Men's Personal and Professional Plans by Spouse Occupation

- By contrast, male SE graduate students' doctoral completion or career intentions were unrelated to their wives' occupations (STEM or not).

Selected Interview Findings: Women's Views and Explanations of their Educational & Career "Choices"

1. What are female science graduate students' **views** of an academic career?
2. How do female science graduate students **explain** their educational and career choices and intentions toward or away from academia?

SOURCE: Canetto, S.S., Trott, C. D., Winterrowd, E. M., Haruyama, D., & Johnson, A. (2017). Challenges to the choice discourse: Women's views of their family and academic-science career options and constraints. *Journal of Feminist Family Therapy*, 29, 4-27.

Findings: What were female science graduate students' **views** of a science academic career?

An academic career was seen by female graduate students as the best route to becoming a successful scientist but as inflexible and unrelenting, and requiring personal life sacrifices

Findings: How did female science graduate students **explain** their educational and career choices and intentions toward or away from academia?

Academia Does Not Allow Room for Family:

'I'm either going to be this scientist who's... well-known for all of their science, and I'm going to publish a lot.' Or, 'I'm going to have my family be more important, and I'm going to do okay in science, but I'm going to be happy with... my personal life'

"I think the whole 'having a family' thing starts to pull women away from their careers because I don't think atmospheric science as a career has found a way to really work with women and family that well. ... I'm hoping things will start to change, but it's a little frustrating."

I like what I'm doing. I want to keep doing it. Kids would be really, really hard. I don't want to go to class pregnant. ... Colleagues have kids. But they're all male. I'd like to be somewhat established. I mean...[having a child] is certainly going to slow down whatever professional career I have... you don't want to be too stressed ..., you don't want to come home all stressed and mad; and you don't want to be on travel so that you never see [your children]."

SOURCE: Canetto, S.S., Trott, C. D., Winterrowd, E. M., Haruyama, D., & Johnson, A. (2017). Challenges to the choice discourse: Women's views of their family and academic-science career options and constraints. *Journal of Feminist Family Therapy*, 29, 4-27.

Findings: How did female science graduate students **explain** their educational and career choices and intentions toward or away from academia

Female graduate students expressed a belief that housework and family carework are women's responsibilities, and that men will not or should not compromise their career for family.

"Down the line you have your marriage, you have your husband to take care of, you have your kids... you have to be the parent, ... the adult."

"His career is gonna come firstMy options are fairly broad, whereas, he's really happy doing the one thing he's doing. "

"[for my advisor, work is everything; he] eats and breathes his work. ... He has a family, he has a wife, ... and he travels all the time"

SOURCE: Canetto, S.S., Trott, C. D., Winterrowd, E. M., Haruyama, D., & Johnson, A. (2017). Challenges to the choice discourse: Women's views of their family and academic-science career options and constraints. *Journal of Feminist Family Therapy*, 29, 4-27.

Why do women leave SE?

Why SE still can't have it all?

Do women "opt out" of SE?



Not because of disinterest

U.S. women desire a prestigious scientific career AND a rich family life, but view the two as incompatible, because they see themselves as responsible for family carework.



SOURCE: Canetto, S.S., Trott, C. D., Winterrowd, E. M., Haruyama, D., & Johnson, A. (2017). Challenges to the choice discourse: Women's views of their family and academic-science career options and constraints. *Journal of Feminist Family Therapy*, 29, 4-27. doi. 10.1080/08952833.2016.1273174

Not by choice but because of lack of good choices

U.S. women “give up” on academic science not by choice but because of U.S. gender ideologies and practices about work and family



SOURCE: Canetto, S.S., Trott, C. D., Winterrowd, E. M., Haruyama, D., & Johnson, A. (2017). Challenges to the choice discourse: Women’s views of their family and academic-science career options and constraints. *Journal of Feminist Family Therapy*, 29, 4-27. doi. 10.1080/08952833.2016.1273174

Cheli, Chief of the European Space Agency, Earth Observation

'My family did not suffer because of my work'

Esa, l'italiana Simonetta Cheli nominata direttrice dei programmi di osservazione Terra



corriere.it

Simonetta Cheli, la signora dei satelliti, direttrice dei programmi di osservazione...
Cheli è il nuovo capo dell'osservazione della terra all'Agenzia spaziale europea.
«Per lavoro ho girato il mondo, la famiglia non ne ha risentito». Dopo gli studi a ...

New film about Colli, a female scientist: “She did not give up her maternal side”

CORRIERE DELLA SERA

⋮

«Una storia al femminile»

Foglietta: spesso il talento delle donne è ignorato Il mio personaggio? Non rinuncia al lato materno

World Health Organization - Italy

28 Nov 2021

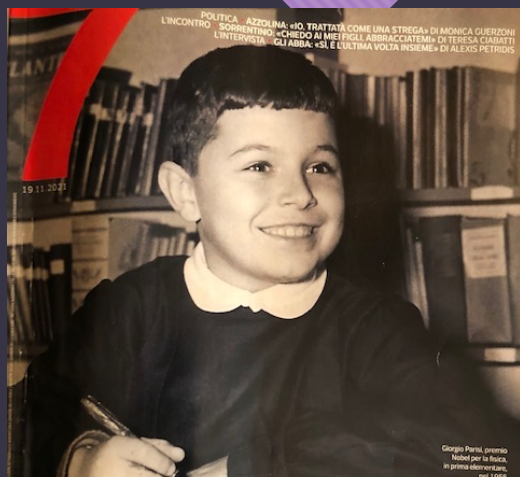
[+1 more](#)

Valerio Cap-

pelli © RIPRODUZIONE RISERVATA



Al microscopio L'attrice Anna Foglietta in una scena del film «Trafficante di virus» dove interpreta Ilaria Colli, una ricercatrice presso un importante istituto zoonofilattico italiano



Giorgio Parisi, premio Nobel per la fisica, in prima elementare, nel 1988



DI ALDO CATTUOLO - FOTO DI ADA MASELLA



1998



George Parnis



Durante un

Implications for future research of the empirical evidence on SE women

- Ask **nuanced** questions
- Use a **diversity** of methods
- Interpret the findings in light of **culture** and **context**)

More implications ...

- Implications of the empirical evidence for those committed to expanding women's underrepresentation in SE education and professions, and to supporting women's advancement to SE leadership roles
- Ask **nuanced** questions
- Before taking an initiative, **review the findings from a diversity of cultural contexts and across countries**, and using a diversity of methods
- Then consider the **specific SE culture and context of your initiative**
- **Design your initiative based on your specific SE culture and context**

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Thank you for your attention!
Questions?

Contact information for Silvia Sara Canetto, Ph.D.
Silvia.Canetto@colostate.edu



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