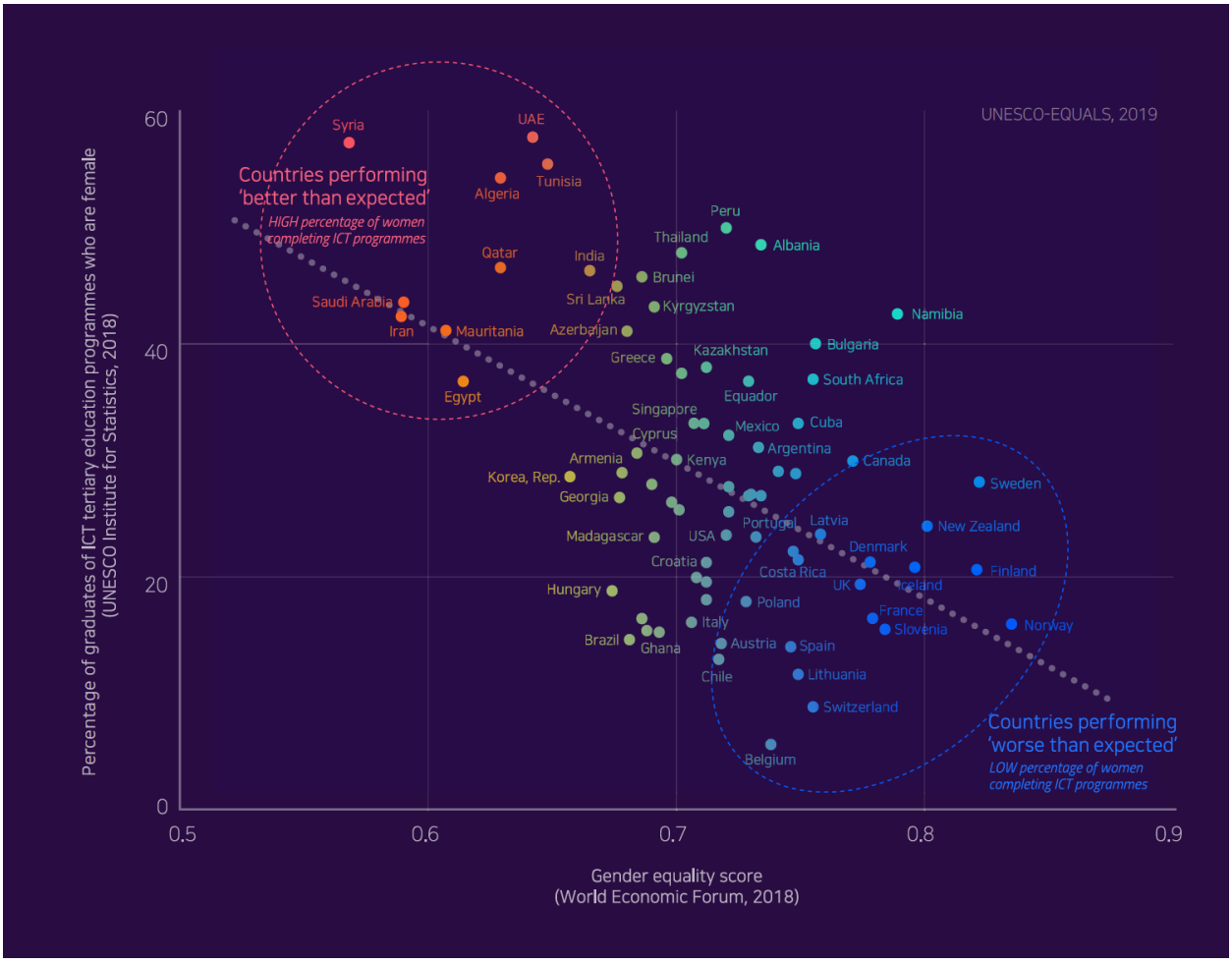
The ICT Gender Equality Paradox: A Counterintuitive Global Trend of Women in Tech

2020 Circumnavigator's Travel-Study Grant Proposal by Mandy Davis



When Hanan was an undergraduate studying computer science in Qatar, her classrooms were usually split fifty-fifty in terms of gender, or if anything, there were more women than men. Women studying Information Systems described themselves as the "IS girls," since that major was so overwhelmingly pursued by women. When Hanan studied abroad in the US, however, she had the complete opposite experience, where she was one of the few women studying computer science. She remembers disliking a hackathon in the US once because of the lack of confidence she felt as a result of being surrounded almost entirely by men. Counterintuitive as it may seem, Hanan's story is no anomaly. Rather, this story captures what is known as the Information and Communication Technology (ICT) Gender Equality Paradox. As shown in Appendix A, the lower gender equality is in a given country, the more women are graduating with "advanced degrees in computer science and related subjects" (West, Kraut, & Chew, 2019, pp. 5). The most memorable statement Hanan made on our phone call went like this: "Mandy, the women in computing community is one big family." This gives me hope that, through this research, I can bring together the one big family of women from Morocco, the UK, France, Qatar, Estonia, and Singapore to understand the ICT Gender Equality Paradox. To actualize this, I will use a comparative case studies approach (Bartlett & Vavrus, 2016) by conducting semi-structured interviews and ethnography in each country.

UNESCO published a report in 2019 that provides two major takeaways concerning this paradox. First, there are divergent findings surrounding women's participation in STEM, so the authors hesitate to provide an explanation for the paradox. The report cites Falk & Hermle (2018) for their attribution of gender gaps in education to gender preferences, and cites Stoet and Geary (2018), who link life-quality pressures to the higher rates of women pursuing STEM in countries with lower gender equality. A study on women in science concludes that "the

primary factor in women's underrepresentation is both freely made and constrained by biology and society" (Ceci & Williams, 2011). A second takeaway from the report is the need for understanding this phenomenon so that effective intervention programs can be created. Currently, well-intentioned efforts to promote women in ICT may be misguided due to a lack of knowledge about the reasons behind these trends. The proposed research will investigate this precise knowledge gap, by seeking to understand how and why the ICT Gender Equality Paradox persists. Three specific research questions follow: what factors (e.g., economic) are incentives for men and women to pursue ICT, and how do these interplay with gender equality? What has helped or hindered women in their pursuit of ICT? How does the gender ratio in educational settings and the workplace influence women's experiences in ICT?

In each of the countries carefully selected from along the spectrum—Morocco, the UK, France, Estonia, Qatar, and Singapore—the general methodology will be consistent. I will interview female ICT students and/or professionals (see Appendices C & D) as well as conduct ethnographies in ICT classrooms and/or workplaces (see Appendix E). With the help of volunteers, I will conduct interviews in participants' native language when possible, in order to retain the richness of their dialect and prevent my sample from being limited to only those who speak English fluently.

Ranked 137th globally for gender equality, a case study in Morocco is vital for gaining perspective on how various aspects of gender inequality might be reflected in trends of who is pursuing ICT. Studying Morocco will also be highly insightful because of the dearth of research about women and STEM outside of Western countries (Hillman, Salama, Ocampo Eibenschutz, Awadh, & El-Said, 2017). My research in Morocco will focus on university students. My contact there, Professor Mina Bettachy from the Université Hassan II de Casablanca, is involved in the

Gender Equality Project at the university and will be able to connect me with students to interview.

In the UK (ranked 15th for gender equality), I will focus on interviewing female ICT professionals and observing tech workplaces. My sample there will include members of PyLadies London (PyLadies has chapters around the world for women who use the Python programming language) as well as women in my own network. I will be attending a London Women in Tech networking event this December as part of a trip funded by the NU For Life Kabiller Award, which I am primarily using to learn about the UK's national computer science curriculum. Thanks to my connections with teachers in the UK and a school year that goes through mid-to-late July, I will conduct a side case study on gender in primary and secondary computing education through observing classrooms and interviewing teachers and students.

With a number of Moroccan and Algerian students studying in France, France provides the opportunity to speak to women who can compare their educational experiences in countries with highly disparate gender equality scores (France ranks 12th in the world for gender equality). I will apply my interview and ethnography techniques at the Université de Paris Sud with the help of Professor Viviane Pons and will meet with members of PyLadies Paris and Duchess France to conduct interviews of female ICT professionals.

Estonia, the birthplace of Skype, is a small country with relatively high gender equality (ranked 33rd in the world), but only 26.99% of ICT graduates are women (West, Kraut, & Ei Chew, 2019); the stereotype of someone working in tech, "a guy with a ponytail (in Estonian: '*patsiga poiss*')" (Külmoja, n.d.), corresponds to this ratio. According to Vanessa Vorteil, board member of the NGO Tech Sisters, women are starting families later to first focus on their career and contribute to their family financially. With this economic role of women paired with the high

paying salaries in ICT fields, the low percentage of women pursuing ICT is surprising. Thus, Estonia is an important case for understanding the potentially non-economic factors that are currently a barrier for women. I will interview women involved in Tech Sisters who are either (a) ICT professionals or (b) women who may have initially faced some barrier to entering ICT but are currently being introduced to ICT. Language plays a significant role in Estonia's higher education system: ICT bachelor's degree programs are often free when taught in Estonian, but not when taught in English, which is important considering the ubiquity of English in programming languages. Vanessa Vorteil also teaches university and secondary school ICT classes in English, creating the potential to include students as participants as well.

Qatar (ranked 127th for gender equality) is a critical case because of the high percentage of female ICT graduates (46.58%) paired with a low percentage (less than 25%) of female STEM graduates (Stoet & Geary, 2018), suggesting there are forces bringing men and women into particular technical fields. Hanan theorizes that the surprisingly high ratio of women to men in ICT stems from a lack of ICT jobs in Qatar, where jobs in "pure engineering" fields (e.g., chemical engineering) are much more prevalent and carry more prestige— computer engineers are not considered "real engineers." Hanan suggests that these trends in job availability, coupled with the immense pressure for men to be the breadwinner, means women can pursue ICT because of interest in the subject, whereas men lack this flexibility. This is a fascinating inquiry to follow, as many would argue (see Falk and Hermle (2018)) that the low numbers of women in ICT relates to a lesser degree of interest in the subject. Qatar will provide a vital reframing of the paradox to consider if perhaps there are not more women, but less men, in ICT within gender-unequal countries. In Qatar, I will be based in Education City and collaborate with Texas A&M University Qatar (TAMQ) and Carnegie Mellon University Qatar (CMU-Q), where I will

interview students and observe ICT summer session classes. Notably, I will collaborate with Dr. Sara Hillman, Assistant Professor at TAMQ, who is conducting research to study the question, "How attractive is the engineering profession for females in Qatar?"

Lastly, Singapore falls in the middle of the spectrum, ranked 67th for gender equality, and with women making up 32.21% of ICT graduates. Researching in Singapore will allow me to examine the role that having a globally leading technology industry might play in the distribution of men and women pursuing ICT. In this way, Singapore acts as an opposing case to Qatar, which has an industry more focused on other engineering disciplines. In Singapore, I will interview female ICT professionals thanks to the connections of a Northwestern alumnus, Alexandra Yeung, who works in the Singapore tech industry.

My three main academic pursuits together reflect my interests and skills related to both this project and my career aspirations. My favorite part of being a psychology major is learning how to conduct and write about rigorous research; I was co-awarded the Winfred Hill Award for best paper in Research Methods in Psychology for the 2018-19 school year. I have additional research experience from working in a human-computer interaction lab and conducting independent research on gender roles and dating apps, for which I was selected to present on at the Northwestern Office of Undergraduate Research Expo. My computer science minor means I have technical knowledge of this subject matter, and importantly, I understand what it feels like to sit in computer science classrooms in my own country. Lastly, my Science in Human Culture adjunct major reflects my interest in projects of this nature. After Northwestern, I wish to devote my career to researching the broader trends and implications of computer science as they relate to equity and education, while being part of the force that makes computer science accessible for all students in the United States.

References

Bartlett, L., & Vavrus, F. (2016). *Rethinking case study research: A comparative approach*. Routledge.

Ceci, S. J., & Williams, W. M. (2011). Understanding current causes of women's underrepresentation in science. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(8), 3157–3162. https://doi.org/10.1073/pnas.1014871108

Clark Blickenstaff*, J. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education*, *17*(4), 369–386.

Falk, A., & Hermle, J. (2018). Relationship of gender differences in preferences to economic development and gender equality. *Science*, *362*(6412), eaas9899. https://doi.org/10.1126/science.aas9899

Hillman, S., Salama, G., Ocampo Eibenschutz, E., Awadh, S., & El-Said, L. (2017). Being a female and an engineering student in Qatar: Successes, recommendations, and challenges. *ASEE Annual Conference & Exposition Proceedings*. Presented at the 2017 American Society for Engineering Education, Columbus, Ohio.

Külmoja, I. (n.d.). Six Myths Keeping Estonian Girls Out of IT. Retrieved November 24, 2019, from http://blog.ut.ee/six-myths-keeping-estonian-girls-out-of-it/

Stoet, G., & Geary, D. C. (2018). The Gender-Equality Paradox in Science, Technology, Engineering, and Mathematics Education. *Psychological Science*, *29*(4), 581–593. https://doi.org/10.1177/0956797617741719

West, M., Kraut, R., & Ei Chew, H. (2019). *I'd blush if I could: Closing gender divides in digital skills through education*.

Appendix A: ICT Gender Equality Paradox Graphs

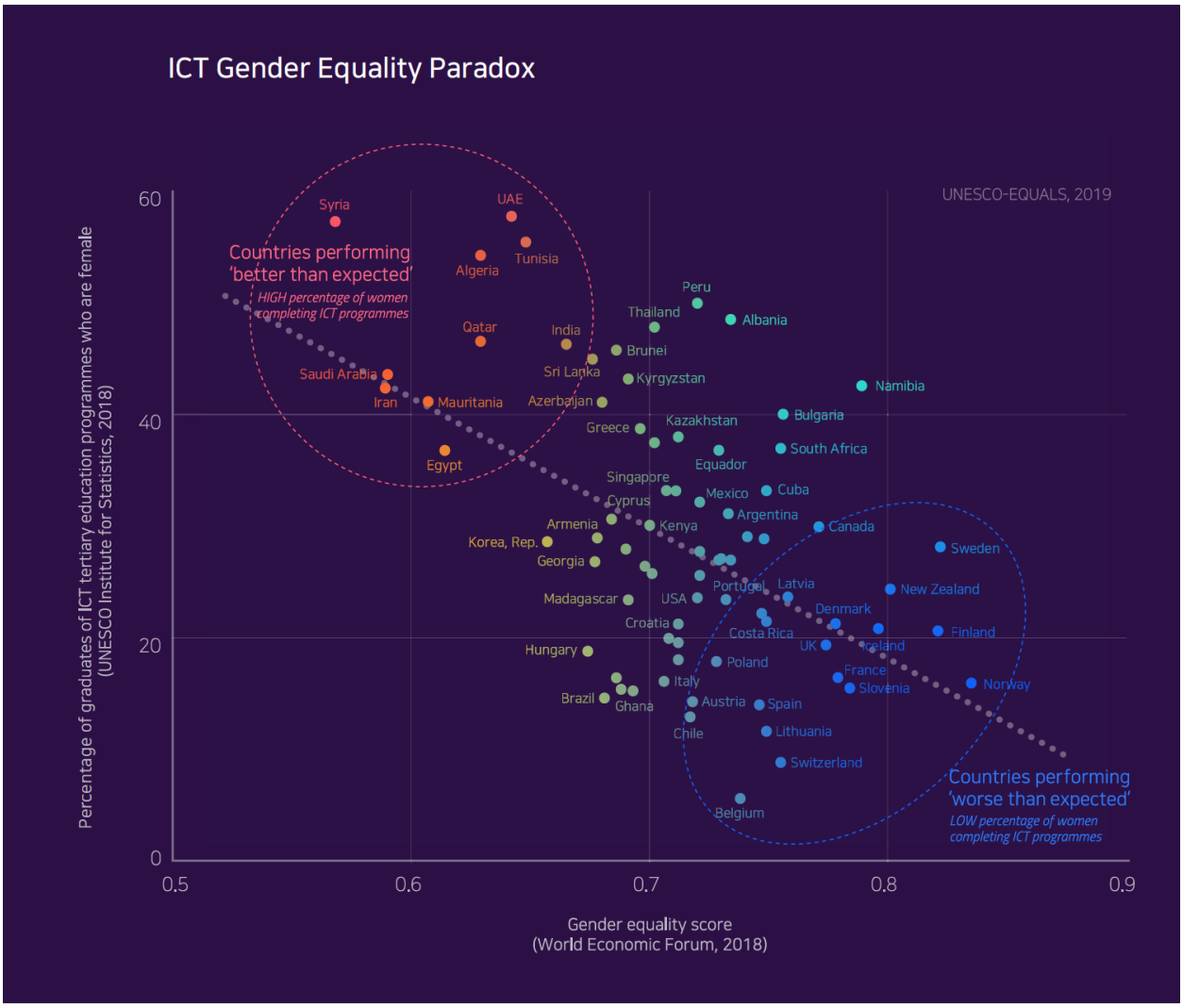
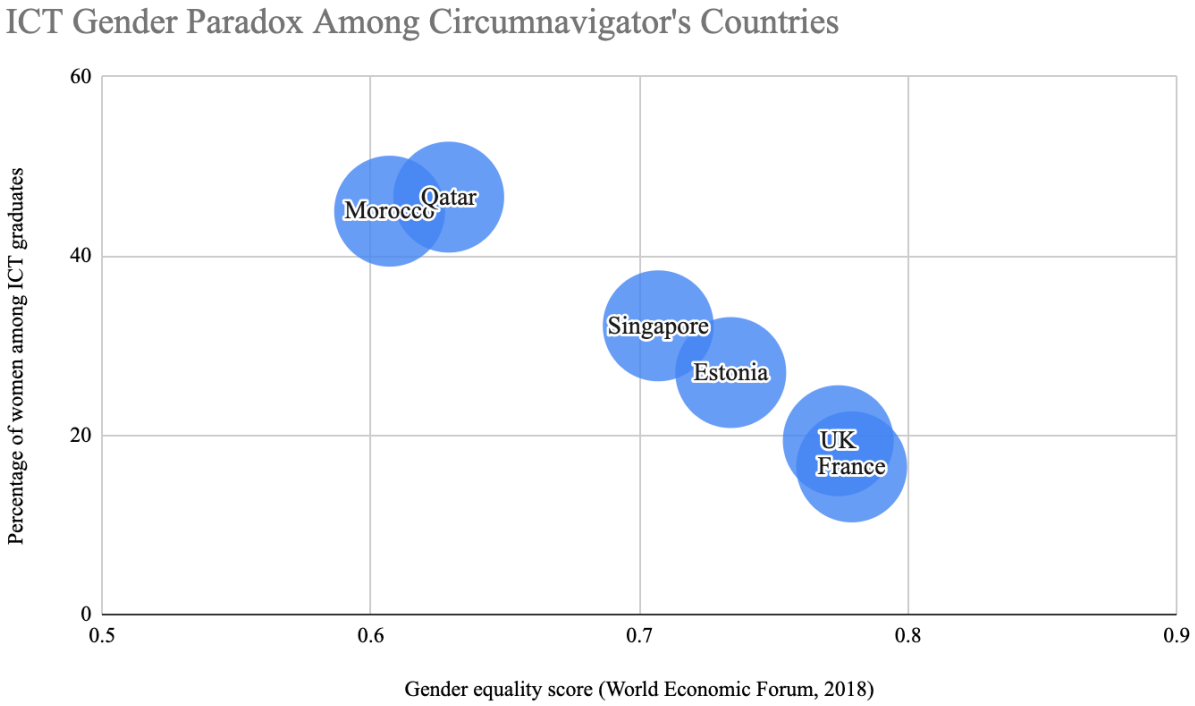


Figure 1: A visual of the counterintuitive correlation between the level of gender equality and the percentage of women among ICT graduates.

Note: Reprinted from "I'd Blush if I Could: Closing gender divides in digital skills through education," by M. West, R. Kraut, H.E. Chew, 2019, *UNESCO-EQUALS*, pp. 76, Copyright 2019 by EQUALS.


ICT Gender Paradox Among Circumnavigator's Countries
Percentage of women among ICT graduates
60
40
20
0
Morocco
Qatar
Singapore
Estonia
UK
France
0.5
0.6
0.7
0.8
0.9
Gender equality score (World Economic Forum, 2018)

Appendix B: Notes on methodology

1. Participants will be given a full range of options at the outset of the interview so that they can select their preferred level of anonymity in collected data and/or research materials that are published or presented in the future.
2. One of the rationales for using a semi-structured interview guide is to allow flexibility for adapting or omitting interview questions in order to maintain the highest level of sensitivity and respect for the participants within each respective country and culture. This also includes adapting language to best align with that of the participants; for example, if an alternate word for "major" is more commonly used, the interview conducted will reflect that difference.
3. Another rationale for utilizing a semi-structured interview is because of the range of backgrounds that participants may have. For example, it is possible an ICT professional does not have a degree in an ICT field, or a degree at all. In this case, the questions in Appendix D regarding the participant's experience at university would be omitted or altered and instead, replaced by questions surrounding the experiences they have had and the decisions surrounding those.
4. Interview and ethnographic methodology will be piloted at Northwestern and in Chicago prior to summer 2020, once granted IRB approval. Namely, I will pilot the ICT Student interview guide with the help of members of Northwestern's Women in Computing club, connect with women in my network who are ICT professionals in Chicago to pilot the ICT Professionals interview guide, and practice the ethnographic component in my own computer science classes.

Appendix C: Semi-Structured Interview Guide for Female ICT Students

The following questions have been adapted from (Hillman et al., 2017) to replicate their inquiry process for understanding the experiences of female engineering students, but adapting this for the ICT field.
Note: *denotes that the question is my own.

Introduction:

- What is your nationality? *Have you always lived in [insert country/region]?
- *How would you describe your family's socioeconomic status growing up?
- What year are you in university, and what is your major?

Background on ICT involvement:

- *Are you involved in any activities related to your major (Women in Computing club, hackathons, etc)?
- *Could you tell me about your journey leading up to where you are today, in terms of studying [insert field]?
    a. *Was there a specific event that you can attribute your reason for studying ICT to?
    b. *Are any of your family members (immediate or extended) involved in ICT? If so, did this exposure contribute to you wanting to pursue [insert field]?

Experiences related to university studies:

- How did your family and friends react to your decision to study [ICT field of study]?
- In what ways does [university] offer a supportive environment to its female students?
- What challenges have you faced, if any, as a female [ICT field of study or broader department, depending on usage] student at [university]?
- Can you think of an experience where you felt you were treated differently than your male classmates at [university]?
    a. Experience of gender bias from professors
    b. Experience of gender bias from peers
- Are you still satisfied with your decision to study [insert field]? Discuss why or why not
- How could [university] better support its female students?
- Is there anything else this discussion has made you think about that you would like to share with us regarding your experience as a female [ICT field of study] student here at [university]?

Future plans:

- What do you hope to do after you graduate?
- After graduating do you feel you will be prepared to work in [insert field]?

Views on the field:

- What do you think are some common perceptions of women working in ICT fields in [country/region]?
- What kind of socio-cultural limitations do you think you might face as a female pursuing a career in [ICT field of study] here in [country/region]?
- How could some of those limitations be overcome?
- What are some of the challenges you think you could face related to being a female [job title] in the workplace? Topics for probing:
    a. Gender bias from colleagues
    b. Gender bias from superiors
    c. Assigned less responsibilities
    d. Lack of adequate training / mentorship
    e. Inability to travel
    f. Lower salary compared to male colleagues
    g. Lack of preparation for job
    h. Having to work in a different field

Appendix D: Semi-Structured Interview Guide for Female ICT Professionals

Note: Many of the question from Appendix C are repeated, as the goal for interviewing both students and professionals is to make sense of the process by which women graduating with degrees in ICT transfers into the workforce. When studying the ICT Gender Equality Paradox, it is important to understand that the proportion of women graduating from these programs does not necessarily translate into that same number of women working within the ICT fields in the workforce, which is referred to as the "leaky pipeline" (Clark Blickenstaff*, 2005).

Introduction:

- What is your nationality? *Have you always lived in [insert country/region]?
- *How would you describe your family's socioeconomic status growing up?
- *Did you go to university? If so, what university did you attend? Around which years were you studying there? What did you major in?
- *What type of company do you work at? What is your job title? Could you briefly explain your major job responsibilities?

Background on ICT involvement:

- *Are you involved in any activities related to ICT outside of work (Women Who Code group, hackathons, etc)?
- *Could you tell me about your journey leading up to where you are today, in terms of having your current job?
    a. *Was there a specific event that you can attribute your reason for wanting to pursue [insert field]?
    b. *Are any of your family members (immediate or extended) involved in ICT? If so, did this exposure contribute to you wanting to pursue [insert field]?

Experiences related to university studies:

- How did your family and friends react to your decision to study [ICT field of study]?
- In what ways did [university] offer a supportive environment to its female students?
- What challenges did you face, if any, as a female [ICT field of study or broader department, depending on usage] student at [university]?
- Can you think of an experience where you felt you were treated differently than your male classmates at [university]?
    a. Experience of gender bias from professors
    b. Experience of gender bias from peers
- Are you still satisfied with your decision to study [insert field]? Discuss why or why not
- How could have [university] better supported its female students while you studied there?

- *Towards the end of university, what did you hope to do after graduating? How is this similar/different to what you actually ended up doing?
- After graduating did you feel prepared to work in [insert field]?
- Is there anything else this discussion has made you think about that you would like to share with us regarding your experience as a female [ICT field of study] student here at [university]?

Experiences related to profession:

- In what ways does your workplace offer a supportive environment to its female employees?
- What challenges have you faced, if any, as a female [job title] at [workplace]?
    a. Gender bias from colleagues
    b. Gender bias from superiors
    c. Assigned less responsibilities
    d. Lack of adequate training / mentorship
    e. Inability to travel
    f. Lower salary compared to male colleagues
    g. Lack of preparation for job
    h. Having to work in a different field eventually
- Can you think of an experience where you felt you were treated differently than your male colleagues?

Future plans:

- *Do you hope to stay in this job for a while, or do you have other future aspirations?

Views on the field:

- What do you think are some common perceptions of women working in ICT fields in [country/region]?
- What kind of socio-cultural limitations do you think you might face as a female pursuing a career in [ICT field] here in [country/region]?
- How could some of those limitations be overcome?

Appendix E: Ethnography Methodology

For the ethnographic component, I will be a full observer in order to be the least disruptive in learning and working environments that may be discussing topics that I do not have extensive background in. However, I will be able to compare the feeling of being a woman in a US computer science classroom to the feeling of being present in computer science classrooms in different countries.

Ethnography in classrooms:

- Describe the layout and organization of the room. Is it a co-ed classroom? Do the men and women cluster with those of their own gender?
    - If possible, take a count of the men and women in the class.
- Describe the aesthetic of the room in general. Are there any elements that relate to stereotypical male/female interests/preferences?
- Tally the number of questions asked and answered by men and women.
- Is there conversation that occurs in moments of downtime? If so, who is participating in this and what are the conversations about?
- What is the style of the class? Entirely lecture-based, collaboration, etc?
    - If students are asked to split into partners or groups, record the process and outcome of this.
- Do the students all have their own personal computers, or are there classroom computers?

Ethnography in the workplace:

- Describe the layout and organization of the room and how this relates to how men and women are situated within the office space.
- Describe the aesthetic of the room in general. Are there any elements that relate to stereotypical male/female interests/preferences?
- If possible, take a count of the men and women in the office.
- What is the workplace culture like (complete silence versus collaboration, etc)? Do colleagues break and eat lunch together? If so, what kinds of discussions do they have?
- Record what time people arrive at and leave work, noting each person's gender as well.
- Do the employees all have their own personal computers, or are there desktops provided in the office?