



Kicking Butt in Computer Science:

Women in Computing at Carnegie Mellon University

featuring Jeria Quesenberry and Carol Frieze as Interviewed by Grace Lewis

Grace Lewis: Welcome to the SEI Podcast Series, a production of Carnegie Mellon University Software Engineering Institute. The SEI is a federally funded, research and development center sponsored by the U.S. Department of Defense. A transcript of today's podcast is posted on the SEI website, at sei.cmu.edu/podcasts. My name is [Grace Lewis](#). I am a principal researcher in the Tactical Technologies Group at the SEI. I am here today with [Jeria Quesenberry](#) and [Carol Frieze](#) who are both professors¹ at Carnegie Mellon University. They are here today because we want them to talk about the success that Carnegie Mellon has had in creating an environment in which almost half of the incoming computer science majors were female, which is amazing, defying a national trend that has showed very little upward movement. You are also coauthors of a book, a recent book, called [Kicking Butt in Computer Science: Women in Computing at Carnegie Mellon University](#). Welcome Carol and Jeria.

Jeria Quesenberry: Thank you.

Carol Frieze: Thank you, Grace. It's great to be here.

Grace: It is great to have you. I'd like to start by having each of us briefly talk about our backgrounds, given the topic that we have today. I want to know how you first became interested in computer science. Did you face any barriers to get to where you are today? So, if you don't mind, I am going to go first, if that is OK.

When I was a junior in high school, I thought that I wanted to study either chemical engineering or chemistry. I wanted to be a scientist. I had always dreamed about working in a lab. That fascinated me. I am going to date myself, but when I was a junior also, they opened the very first computer programming class at my high school. PCs [personal computers] had just been launched and become somewhat accessible.

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That changed everything for me. To me, it was the creative process. I felt like it was something very creative. Like I could sit in front of a computer, write some code, and something happened. To me, that was great. Then I said, *OK, forget chemistry. This is what I want to do.*

I ended up majoring in software systems engineering. The curriculum, I would say, is a basic engineering curriculum. It has computer-science subjects, and it has software engineering subjects, which ended up being a very good match for me. Even though I was born and raised in the U.S., when I was a junior in college, that same year we moved to Colombia, South America, for family reasons. That is where my parents are from. I am a first-generation American. They are from Colombia, South America. That is where I did my major.

I was part of a 50-50 male-female class. That is pretty normal down there. Even in a lot of the engineering [programs], not all engineering, but most of engineering [programs], it's a 50-50 class. When I came to CMU [Carnegie Mellon University] in 1999, I was shocked. I was shocked because during orientation I was the only female. I later found out there were two more. One was a part-time student. The other one was doing a master combined. They weren't part of orientation, but just me, being the only one there, to me was shocking.

Coincidentally, 1999 is a big year. I'm sure you'll be referring to it. I was walking down the hallways and I see this sign that says, *Come join us [Women@SCS](#) [School of Computer Science] Group just starting. I am, like, I have to go there because I have to see where these women are because they are not with me.* I have to say it was one of my favorite memories of Carnegie Mellon, being part of that group of wonderful women with Carol. I am sure that you are going to be able to talk about that later. So, what are your stories?

Carol: Grace, that is such an interesting story. In my field, I am always interested to hear how women got into the field. But my story is a bit different, right? I am not a computer scientist, but I have worked in the School of Computer Science since [Lenore Blum](#) joined, and women at SCS started thriving back in, as you said, in 1999, when we first started seeing, at the undergraduate level, more women coming into the program.

So, my background. I am from England. And back in England, I was in teaching. I was a teacher for most of my life. My background is in cultural theory and cultural studies, with a lot of gender studies in there as well. But I have to say, when I first started working in School of Computer Science, I had the same kind of stereotypes about who was in the field, who fits this field, what the field is, I think the general public have and still have.

But when I got there and started meeting students and talking to them, I soon realized, *Hey there's something different at Carnegie Mellon.* Did you, you asked about barriers? The barriers we faced? I cannot say I really faced any obstacles in my career since I have been here. But I've



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had some really interesting discussions with people about, you know, *Why do we need something like Women at SCS. Why do, you know, are we favoring women?* You know, you kind of have to discuss issues of bias, how bias gets formed. So, some very interesting discussions over the years. But I think I have had fantastic support really. Faculty, staff, students—everybody's been on board to make the success that we see today. So, I cannot really say I've had any tremendous obstacles.

Grace: Okay, what about you Jeria?

Jeria: Well, thanks Grace. Like you and Carol have unique stories, I think my story is a little bit different as well. My dad actually works in the computer science field. And so, growing up in the '80s and '90s, my home life was always filled with technology. We were one of the first families to have a [Commodore 64](#). We played [Nintendo](#) extensively. My parents actually gave me my own phone line for Christmas when I was in middle school, which I thought was super cool. Only come to find out many years later, it was so my dad could use the modem to dial up and check email at night.

So, I kind of grew up with this idea that technology was just something you have and you use. And it wasn't until I got to college, in the mid-1990s, when I began to realize that was not the case for everyone. And on the floor in my dorm I was actually the only student, the only woman, who had a desktop in her dorm room, knew how to get on the internet, knew how to establish an email account, do some of these things that I thought were very basic. And I became sort of the go-to person amongst my friends to help them solve problems and get through working with technology. And I just really enjoyed exposing others to things that you could do with the computer and with technology.

And so, I had been an undecided major. In full disclosure, I had no idea what I wanted to be when I grew up. I still don't, in some ways. But because of that experience, I decided to pursue what was called [management information systems](#). So, I am more of an IS person. I spent some years in industry working in consulting, helping companies to use technology to solve problems, which was quite rewarding. And I always wanted to go back to the classroom and educate. And so, I decided to pursue a PhD in the field. And it's been a really wonderful opportunity for me.

Carol mentioned some barriers that she's encountered, and I would agree in that I really haven't encountered overt barriers myself, either. I have always had support from parents and my teachers and my advisors. But I do think there have been many times in my career where I have come up against a few, kind of, implied barriers or assumptions. Just as one quick vignette or example, I recall when I was in graduate school. So, this was sort of the 2005 timeframe--not that long ago, really, in the whole scheme of things. I was talking to another graduate student. He was also pursuing a PhD. And I told him I was doing research on women and why they chose to



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study technology fields. And he said to me, *Well, I think the reason women don't pursue this field is because they have troubles reasoning three-dimensionally.* And I said, *Excuse me?* And I thought perhaps he was joking, but in fact he was quite serious. And I said, *Well, I just have a hard time believing that because I can reason, you know, three-dimensional type problems and challenges.* And he said, *Well, I want you to imagine a shape in your mind.* And I was like, *okay.* He said, *now rotate that shape.* And I said, *Okay.* And he said, *Well, a sphere does not count.* And again, he was not kidding, he was serious. And for me, that was just kind of an indicative moment about how sometimes barriers may not be completely obvious. But, these assumptions there are, a little bit underneath, can be difficult to overcome if you are not the type of person who's confident and, sort of, assertive and able to push through those.

Grace: So, thanks for that.

Carol: Can I just say something as well? So, I think these stories that you hear about these guys that—often guys anyway—that say these kinds of things. I think it's not just about computer science, right? These are issues about gender bias in a broader culture. Just more enhanced, I think, in fields like computer science, where there are fewer women in the field at specific times.

Grace: Actually, that is a perfect lead-in to something else I would like to discuss today. So, the U.S. Department of Labor estimates that, by 2020, there are going to be more than 1.4 million computing-related job openings. Unfortunately, I think it is safe to say that most of these jobs will be occupied by men, because just using some data from 2015, women earned only 18 percent of computer science degrees, according to the National Center for Education Statistics.

However, it is great to see that at Carnegie Mellon things are different. In 2016, you welcomed 46 percent women in computer science. This year was amazing, almost 50 percent. Like 49.7 percent. It came so very, very close. Can you please talk about some of the steps that CMU has taken in creating this environment that is welcoming to women?

Carol: Yes, Grace. I am happy to tell that story. And there were several steps, and after some major steps we had to sustain what had started and build on that as well over the years. So, it's taken quite a few years, but we have reached a good point, I think. So, I'd say, just the beginning of the story as you pointed out earlier, back in the late 1990s, there were probably 5 to 9 percent women in the computer science major at Carnegie Mellon. Very few women. And probably one of the worst places to be a woman in computer science: it was a very techy, geeky, kind of environment culture dominated by guys who looked alike, thought alike.

So, the first step—the first major step—was really paying attention to that situation, noticing how few women there were, noticing that women felt like they didn't fit, and, many of them were leaving. So, it really was very important. Faculty started paying serious attention to the



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issues. And that was a big step, big first step. Then, I'd say, the next big step was, *What do you do about this?* Right? We had a wonderful dean. We've always had wonderful deans, actually. [We've] been very fortunate. But, at the time, Dean Raj Reddy had this vision that Carnegie Mellon should be producing leaders in computer science, not just hot shot programmers. Not that there's anything wrong with that, but, you know, leaders in the field. So, *How do you do that?* What was, *How do you go ahead and do that? How do you bring that vision about?*

So, the next step, really, was thinking about how to do that and looking at admissions. [The] admissions criteria had always been that you bring in people with a background in computer science, which happened to be majority male. So, they decided they would drop the programming background, drop that computer science background, still focusing on, you know, high SAT scores, students who had interest in technology. But that background was an obstacle, in many ways, to many students. And that is when we started to see more women coming into the field. But also more students, men and women with broader personalities, broader range of interests. We started to see a different student body at that point.

And then, I'd say, the next big step that I got very involved with is when they hired, brought in [Professor Lenore Blum](#) with her great background in promoting women in math and science. So, she was hired. She was instrumental in making Women@SCS really thrive. It was always very much student run, if you like. But, she kind of made things happen. And Women@SCS has always been motivated by ensuring the men and the women have the same opportunities. If the women are missing out on something, we made it happen for them: mentoring, networking, and visibility. Lots of leadership opportunities where the women had visibility.

So, what we started to see, then, is women become very central to the culture. And the more central they are the more they are in a place to help change the culture. So, you know, it was a gradual process over the years. So, there was this belief that women could lead the way, and Carnegie Mellon trusted women, trusted women to--they believe women and they believed in them. And it has paid off. It has paid off in that now, you know, we have become a role model for gender and inclusion. So, we are a source of pride as well.

Grace: That is wonderful. So, Jeria, let me ask you something, because I know this is very related to the studies that you have done over the years. I recently read on computerscience.org that high school girls account for more than half of advanced placement test-takers, yet boys continue to outnumber girls. I believe it is four to one in Computer Science AP exams. Just as a piece of data in 2014, in Mississippi, Montana, and Wyoming not a single girl took the AP Computer Science exam. Do you have any thoughts as to what can be done at the primary and secondary education levels to provide more resources and support for girls that have an interest in technology?



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Jeria: Grace, that is a really great question. And I should--I'm actually from Montana myself--so, you know, I would really like to see a change. And see more girls throughout our country be interested in computer science. Before I speak to specific recommendations, because I do have a few, I'd like to share two meta thoughts, or comments.

And the first relates to cultural shaping. This idea that men and women are situated with different intellectual abilities is something that, I think, is very focused here in the states, in the U.S. and in many Western nations. But the idea that women can't do technology work, that is not pervasive globally. In fact, there are many countries throughout the world where they are encouraged and do pursue technology degrees. So, I think it is important to keep in mind this cultural shaping is a part of the reason why men and women and girls and boys are pursuing and not pursuing CS courses.

The second meta comment really speaks to some of the themes that Carol mentioned, about ways in which the culture can be improved to benefit both men and women, both boys and girls.

Through the work that we have done at Carnegie Mellon and through our research, we have found that really making the culture more inclusive is a win-win. It allows for students to really pursue interests that can cross a spectrum, a range of areas. And so, any type of intervention or recommendation to really open the idea of who is a computer scientist, I think, this is a positive change for men and women.

That being said, in terms of specific recommendations, I think if we look at the K through 12 program in which computer science is in our schools, there's a lot of room for improvement, a lot of areas that we could work on. There is a consortium that's come together, [K-12 Computer Science Framework](#). It is a really lovely resource to help institutions, schools, educators, administrators think about, *What are some of the curriculum guidelines that we should target if we're thinking about deploying a CS initiative? How might that vary by age or range? So, what do the learning outcomes for a second grader look like in comparison to say a high school senior?*

Some of the big tech firms, like Google, they have a project called [Google for Education](#) that has a number of wonderful resources for CS instructors or those who, perhaps, are charged or asked to teach CS concepts in the classroom. [TEALS](#) is another program that Microsoft supports. That is quite wonderful as well. Something that they do, I think, that is really creative is, they will identify professionals, computer science professionals, and then have them work in collaboration with teachers and educators to talk about the profession, and talk about challenges and problems, and kind of establish role model type personas with the students.

In terms of additional interventions, I think there's a lot of really wonderful groups that are coming online to help encourage and give females opportunities to think about computer science



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and what it means for them. [Girls Who Code](#) is a group I think that's only been around about five years or so. But, now they actually have clubs in every state in the country. And so, they have a big push to try and really build a community among young girls. And then, also, offer them courses and instructional material to think about how software development, how computer science, can be relevant to their lives. [Code.org](#) is another great resource with a lot on, kind of, learning to code, teaching others how to code.

Grace: My kids are big fans.

Jeria: Yes, isn't it great? And they have such wonderful connections to other popular movies and music and things like that. So, really draw upon a variety of interests. [Made With Code](#), this is another Google initiative, and they have some wonderful examples of what you can do with code and allow children, men, and women to come in and kind of work off of that and explore their own creativity.

And then, I'll just add too, that I've seen recently that Girl Scouts is putting together a new program, where they want to target, specifically, computer science. And they are going to be bringing that online later this year. So, I think there is a lot happening in the space, which is really exciting. I'd also just like to mention that universities, two-year and four-year institutions, offer a lot of programs as a part of outreach. And Carol talked a little bit about Women@SCS, but that group's been very active in outreach with our local community. And I think other universities throughout our country are trying to do that as well.

So really, overall, I think if you are a young girl and you cannot see yourself in computer science, then you will likely not pursue it. So, any kind of activity that we can take or initiative that we can take, that can show them that you fit here, too, can be really productive.

Grace: That is great. So, in our podcast we always try to highlight the ways in which our work can be transitioned to the public, to the community. So, if you are an educator, an administrator, and you are listening or watching this podcast right now, what steps can they take to create a more welcoming environment? And what are specific things probably from your experience you could recommend for people to do? *I am going to do this, I am going to start right now.*

Carol: Yes, that is so important, Grace. Yeah, we do need to work with educators, right? Especially teachers. They have, I mean they are there, right? They can reach out to so many students. And to parents. We need to reach all these groups. I've actually heard of teachers going into math and science classrooms recruiting girls to their computer science. Taking a computer science girl along with them. So, you do not have to talk about gender, but you've got this girl there who is in computer science and she is trying to tell them what an exciting field it is and, *You should join Mr. So, and So's computer science course.* We know there's a shortage of



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computer science teachers. So, we have to be creative in that way. So, I am always happy to hear their stories. And, one of the things we've done at CMU, we've run workshops for all teachers and even if they are not in computer science. We can show them how you can bring computing technology, computing ideas, or computational ideas, into math and science classrooms.

But, you know, really to go back to your point, what can you do right now? Information is really powerful. And I think with computer sciences, as Jeria and you pointed out, a lot of the information we get about computer science is misinformation. We are still kind of building this knowledge, which is really based on stereotypes. So, we have to work with teachers to dispel those stereotypes about the field. And, I think Jeria also mentioned this.

So, one of the things I know Pittsburgh teachers are doing, they are hooking up with groups like ours, Women@SCS, to do outreach, bring kids on campus. Actually, I really like bringing kids on campus because not only do they get to meet our students, they get to wander around. They get a sense of college atmosphere. Or, we can go and visit them if that is not possible. Bringing in speakers from, I know many Pittsburgh teachers are bringing in speakers from our school, from Carnegie Mellon, female speakers, and from the tech industries. We are fortunate we have growing tech industries that are available and happy to come out and do outreach.

Then, what's also really important that we can, we need to get across to educators and parents what you alluded to--that this is where the jobs are, right? Careers in this field are growing all the time. This is where it's all happening. This is the future. Everybody, all these different companies want computational skills. So, this is where the jobs are. And, you know, teachers and parents want to know the next step. You know, *Where are the kids going to go?* They want to know there is a future. They are going to get a job.

So, this is, I think this is important. If we can get to teachers, get information to them, and they can [work through] PTAs, or parents' evenings, to pass along this career information, I think [this] could have a really-make a big change in people's understanding. There is one other thing I want to mention that is not--it can be understated. But I think it is very important. The media, you know, kids and all of us are surrounded by a very visual culture. So, we need to counteract that in many ways. And, I think, in the classroom teachers can look around. *What's going on? What kind of posters, images are surrounding kids? Can we not add to whatever's there or make sure it's gender balanced in some way.* In corridors, places like that where we can simply put up images. There is some research that shows just seeing, just seeing an image of a female scientist can change a girl's perspective.

Grace: Because they can see themselves in that image.

Carol: See themselves, if you can't see it, you can't be it.



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Jeria: Yes, I would just add to Carol's comments, that I think any way in which we can encourage parents and teachers to not box our children in, to recognize that these stereotypes are just that: stereotypes. But that the computing field has so much to offer to everyone. And so, as our kids are growing and exploring, encourage them to look at places that you may not think at first hand would be a good fit. Because in fact, they just might be.

Grace: Right. So, what is next for both of you? I mean you guys work great together. What collaborations do you have? What are you working on independently and together to get more work like this out?

Carol: Well, we just finished up another interview study, which we've analyzed but we have not actually written it, not yet. So, I think that's probably our next step. Yes. I love working with Jeria, she is a great colleague. We share the same vision, the same ideas, and so we will continue to work on new projects.

Jeria: Yes, I love working with Carol as well. I mean we've been doing this for so many years that you kind of get in that routine of you know what the other person is thinking before they even say it, sometimes. So, I think we have just a wonderful work relationship. And a lot of fun too. But yes, more writing. We have some data analysis we've completed. So, we want to write that up. And I think, through our conversation today, the importance of culture and cultural shaping is really important. And, I think that is an area that we'd both like to continue to look at and dive a little deeper into.

Grace: Yes. It does. So, I just want to ask one final question. At the beginning, I said you were both coauthors of the book, [*Kicking Butt in Computer Science: Women in Computing at Carnegie Mellon University*](#). If you were to provide the cliff notes, what is the summary of that book? What is the essence of that book?

Carol: That is a great question.

Jeria: Great question. Because it is quite a long story.

Grace: It is.

Carol: Well, men, boys, and girls--men and women--do not necessarily have different brains, right? Different intellectual potential, which is a thing that's been the struggle. Facing up to this "men are from Mars, women are from Venus" kind of mentality. That is why we try, the message we try to argue against in the book is that.

Jeria: And I think, too, to show a positive story, a success story. So, much that we read--statistics can be somewhat depressing. And so, we are trying to get to this idea men and women don't have a different intellectual brain. And we can both succeed.



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Grace: Right, and your future work is building on that idea and trying to bring more data and more insight. That is great. So, I would like to thank you both for joining us today.

Carol: Thank you for having us.

Grace: Also, please note that we will provide links to the resources mentioned during this podcast in our transcript. This podcast is available on the SEI website at sei.cmu.edu/podcasts on [Carnegie Mellon University's iTunes U site](#), and also on [SEI's YouTube channel](#). As always, if you have any questions, please don't hesitate to email us at info@sei.cmu.edu. Thank you.