

When it Mattered

Episode 30: Heather Knight

Chitra Ragavan: Her dad is a former engineer who built lasers and propulsion systems. Her mom is a multilingual former Peace Corps volunteer. Heather Knight has molded his mind and her heart into a very unique field of robotics, building emotional, playful, social robots. Hello everyone, I'm Chitra Ragavan, and this is When It Mattered. This episode is brought to you by Good Story, an advisory firm helping technology startups find their narrative.

Chitra Ragavan: Joining me now is Heather Knight, Assistant Professor of Robotics at Oregon State University. Her charisma research group uses methods from entertainment to bootstrap the development of social robots. Knight also runs Marilyn Monrobot, a robot theater company with comedy performances and an annual robot film festival. Knight was named to the Forbes list 30 under 30 in science, in 2011 and Ad Week's top 100 creatives in 2017. Heather, welcome to the podcast.

Knight: Thanks for having me.

Chitra Ragavan: Tell us a little bit about yourself and how you first became interested in this area of robotics, and in building these so-called charismatic social, playful emotional robots.

Knight: Well, I fell in love with robots by building them. I went to MIT as an undergrad and my freshman year someone in my dorm worked in a robotics lab, and just so it was a random internship and they made really cool robots that related with people, and had expressive faces and listen to the tone of your voice and it was just a lot of fun to see how people reacted to the systems that we're building. I was hooked.

Chitra Ragavan: What were your areas of interest as a kid and did that influence your career decision in any way?

Knight: Well, I always liked reading and traveling. I was on the debate team for a little while. It's kind of funny because I was trying to decide between engineering and writing. I wanted to be a writer at one point, but these days I get to kind of write robot characters by building them and coming up with their software.

Chitra Ragavan: That sounds absolutely fascinating. Your research group is called CHARISMA. What does that stand for and what does it mean to have these so-called performing charismatic robots?

Knight: Yeah, yeah. I've really fallen for the word caring charismatic robots, like our phrase charismatic robots over the last, I don't know, 10 years. This idea that you could have machines in your life that are useful, but they also add value and that you enjoy being around. So, that's what I really mean by using the word charisma. But as a nerd, of course we have to make everything in acronyms. So it's Collaborative Humans and Robots: Interaction Sociability, Machine learning, & Art. And that's the name of my research lab at the Oregon state university.

Chitra Ragavan: And what are the kinds of things you do there, what are the coolest stuff, coolest things you do?

Knight: Yeah, so I have a bunch of students, both graduate students and undergrads and computer science, mechanical engineering, electrical engineering, mostly even human computer interaction. And we make robots that operate around people. So, half of our stuff is like robot furniture, really simple robots or robots that are running around the building asking you to do exercises. And then the other half of our stuff is robots that can be in performance settings. So, we have a comedy system. We had a robot that was in an opera and one of the music department's productions this past fall. It was playing a statue. So it was well cast.

Chitra Ragavan: So, tell us a little bit about the history and evolution of social robots and kind of how it dovetailed with your career and interests. I know you worked with one of the key people in the early days whose work led to the evolution of this.

Knight: Yeah, absolutely. I mean, I said I fell in love with robots by building them, but I was also building them with someone super inspiring. So professors, Cynthia Brazil, she is, you know, kind of the mother of the field of social robotics. So she had created in the late 90s this robot called Kismet that imitated infant caretaker, interactions. It had big eyes and it, if you were giving it too much information, it looked overwhelmed, so that you'd slow down.

Knight: And so, she was working in an AI lab, and so her idea was that we could use these social strategies of communication to be able for the robot to kind of limit the data that it was receiving from you to a level that it could handle. And so, by using these cues we just sort of automatically is like, "Oh no, okay. He's tired now. I need to wait

till later." So much like we would do with like a student learner that's a person you know or even a kid.

Chitra Ragavan: So what's the current state of play in robotics? I mean I guess most people are familiar with the Roomba, right? Is that the vacuum that goes around? But what else is going on in the space?

Knight: Yeah, robot vacuum cleaners have definitely been the most successful consumer robot so far. Do you know that cows have a lot more robots than we do? Like they're surrounded by robots. They have robots that like scratch their back, that helped milk them. Like cows, they've already received the robot revolution. It's kind of funny. And they really like them, they're like, "This feels good."

Chitra Ragavan: You mean on farms and things? It's all-

Knight: Yeah, like in farms like so, you are very full udders, it's uncomfortable. So you can just walk yourself to the milking station. Like it's not the robot chasing you. It's more like, "Oh, of course I want a back massage right now." I mean I would want that.

Chitra Ragavan: So, how did you start building these things? How does one go about it?

Knight: Yeah, great question. I mean there's so much more stuff out there right now. So I think, I've been in the field for like 18 years now, and when I started was around when the Roombas were first coming out and there was no such thing as like drone wedding photography or you know, now there's even these like security robots that operate in some malls and stuff that are also starting to like, I don't know, give coupons or other kinds of stuff. Like the use of robots has become something that we're actually familiar with now. Whereas, it was only Scifi when I started. So, it's been fun seeing robots on the shelves now.

Chitra Ragavan: Yes. And I think on a lot of college campuses now you're actually having robots deliver pizzas.

Knight: Yeah, yeah. But you know, pizza, burritos. Yeah. Sometimes they actually have people in like less expensive labor economies controlling those robots, which I actually think is a kind of useful solution because it is hard to program all of the possible social rules and expectations that we have for robots into a robot that's running around with like bicycles and people and skateboards on a college campus.

Knight: So, I mean a lot of these systems have humans in the loop when they're in really complex spaces. And I actually think that that's kind of neat because it is really difficult to kind of get up to speed in the human world. So, when we can collaborate with robots, that's a big direction of the field right now rather than automation is collaborative robots. At least for dealing with applications that are around people. So I think that's kind of neat.

Knight: So we could literally have a person in the loop like the Wizard of Oz or something. But I could also, you know, just have someone nearby or if the robot gets lost it can be like, "Hey, could you touch the place on the map where we are, because I'm totally lost?"

Chitra Ragavan: Fascinating. And you had a reference on your website to Minimal Social Robots. What does that mean?

Knight: So, I'm referring to robots that don't have those big eyes and expressive faces. So, you always have to be a little bit different from your parents. Right? So, it's Cynthia is my academic mother and like Reed Simmons at Carnegie Mellon who I did my PhD with. But yeah, I'm really interested in things like chairs or boxes or even like a little like swimming robot under the water or a drone. So, how can they communicate through emotions? Or be curious.

Knight: So if you had a drone that was sort of in the area but it was kind of peeping out from behind a tree, you would immediately be like, "Oh, I wonder if it's curious about me. But it's also a little shy." So, I've been having fun using either groups of robots or sequences of motion or relative location and stuff to try to communicate through channels that even simple robots have.

Chitra Ragavan: And one of the areas of interest for you is the multi-robot, multi-human interactions. How does that work?

Knight: Yeah, so at the beginning of the field, a lot of were thinking about these one on one interactions. So we mentioned the infant caretaker. You could also think of like in movies, like you have the robot servant, that's just bringing scrambled eggs or whatever it is, but the use cases of robotics that sometimes are most effective from a cost perspective are where you have lots of people. So, robots are kind of expensive for all of us to buy.

Knight: So maybe instead of us all having your own personal robot, we can have robots and museums or robots and restaurants, robots on stage and then or groups of robots at a reception that are delivering

food. But then the lights change and like they all do like this little disco number and then they go back to being the servers again.

Knight: So, I you could just particularly in that minimal robot case like that where they're really simple form, there are these things that you can do and formations of robots that are much like choreographing dance, that that I think are really fun to play with or that I would like to see more of in the future.

Chitra Ragavan: As your work evolved, you started looking at combining entertainment with robotics and you set up your company, Marilyn Monrobot. What does Marilyn Monrobot do, and how do you combine entertainment with robotics?

Knight: Great question. Yeah, so Marilyn Monrobot was a robot theater company that I started leaving like 2012, when I was living in Brooklyn. It was fun going to like city hall, and registering my little company. But yeah, I was doing a lot of engineering work at the time and I was excited to just have an umbrella for doing really creative projects.

Knight: So we started out and we were doing robot comedy. I had a history before of designing Rube Goldberg machines in LA with a group called Sin Labs. We did a music video with Okay Go, This too Shall Pass, which was really fun. So we had made an interactive art installations and it's just funny because, looking back I kind of just thought the interactive art stuff or technology based art was just a kind of side hobby to keep things fun and Marilyn Monrobot kind of started that way.

Knight: And now I have my entire lab CHARISMA that's around that and you know, students that are working for me and believe that, I mean what I'm saying and coming with all these great ideas. And so, now we've been doing stuff in CHARISMA with like robots and improv. Like I mentioned the before, this robot that was actually in an opera production, in Don Giovanni, like they come up with as many ideas as I do.

Chitra Ragavan: What was the most creative one that you've had?

Knight: I mean, Data the robot, my now robot. I mean this is like my seminal co-performer, it's funny because we were performing comedy together or before the first, the now robot, both were now robots, but at first Data, then Ginger for like seven years. And so, we would do shows like once or twice a month all over the world

actually. Like we've been in Israel and you know, a lot of Western Europe and across the United States.

Knight: I think I brought one to Mexico one time. I mean we've been all over the place and it was, I'd be on the airplane with the robot, and we'd make jokes with the security guards. Oh yeah, in India I told them that I had a robot named Ginger, and they're like, "Oh, is it's sidekick Tamari?" So, I had this long journey I think when you go on tour with a robot. So, I used to joke that I would get in trouble if I didn't say that Ginger or Data were my favorite robots. So between the two of them, they're my favorites.

Chitra Ragavan: What was it like when you began to pitch this idea of researching, combining entertainment and robotics and you know, of robot opera or whatever. Did you get a positive reaction or did you get some raised eyebrows from the establishment?

Knight: I think as long as it was a hobby. It was fine. It's just when I started to make that my career, the people were like, "What are you talking about? That's crazy." But you know, as they say, sometimes when people call you crazy, you know you're onto something. Because if it didn't seem crazy, someone else would've been doing it already. And you know, there are a handful of people that have played at the intersection of entertainment and robotics, but you know, honestly like we all know each other.

Knight: If this is like, you can count them on the fingers of your hands. Like we had a really phenomenal day long art and robotics workshop in Montreal last March at this big robotics conference, and it was so fun. Like it's so fun to see people that are working at this intersection. So, I'm completely in the fine arts space. We even had a person there from CIRC du Soleil who was like talking about how they've integrated robots stages and so on. Like there's some really interesting work out there, but yeah, but it's still kind of a small crew, but we're enjoying it.

Chitra Ragavan: You've held a robot film festival and done some robot storytelling. How does that take shape? What happens at those events?

Knight: Yeah. So, every year there's a... it's kind of a small festival, but it's a short films festival. So we'll have a couple hours of screenings of that. The latest and greatest of robot, short films, they can be real or fictional. There's always a lot of great music videos that can be comedic or serious or sad or romantic. And it's been a lot of different cities. It started in New York city, which was really fun because we had a red carpet like robot awards ceremony.

Knight: So, we were trying to basically get people talking across disciplines. We want artists to be there, we want filmmakers to be there, we want technology people to be there. And it's funny because so many of the years people think that the film makers are going to have the best films, and they always have really great storytelling. But like sometimes the guests of the audience come from like, "Wow, we didn't even know that this existed."

Knight: Like there was one year we had this just balloon arm. I think it was like it was weird. It's a Mylar balloon, and they inflate and deflate it and it could reach up three stories. And so, it was this controllable, weird balloon arm and it was like a 46-second video. But people are just like, "What is this? This is just crazy." You know? I was, that's why reaction, that's part of why I put it in the festival.

Knight: But it's just a great way to see what's out there, and I really think that storytelling has the power to shape what we want to create. So, filmmakers can influence like even what it occurs to us to build and also kind of critique some of what we've currently created. But also robots are just very photogenic. So it's fun to watch them on camera and it's much harder to read about something that moves then see it.

Chitra Ragavan: I just read an article about the Consumer Electronics Show where they had a robotic emotional playful cat and the big eyes and the cat can play with toys and it was, I think a big hit at the show.

Knight: Cool. Yeah, that makes a lot of sense. Like, yeah, CES every year. It's always like robots are born stars.

Chitra Ragavan: One of your goals you told me the other day is to bring creativity and laughter and playfulness into technology and into engineering. What's missing and what do we need and how do we go about it?

Knight: Yeah, that's a great question. So, I mean engineering is just such a creative discipline. It was so interesting going to college and thinking I didn't know exactly what engineering was but I definitely thought it had something to do with math and science, and that's true. But what I didn't know is that also had just as much to do with art class cause that was the one class where you would just make something up and then like paint it or build it or sculpt it or design it.

Knight: And engineering is such a creative process, and like it's creative and figuring out like how to build it. But it's also creative in filling out what you should build or what you should be trying to do in the first place. So, I really like the idea of having more creatives like in

meaning more from like the humanities style, performing arts, like just people with big imaginations in engineering, because they can help us dream up the future.

Knight: And so, in the same way the robot film festival lets the film makers sort of illustrate some crazy wacky ideas or critiques, like having people that really think about people are a great way to make technology that can impact the world and like in let's say charismatic ways.

Chitra Ragavan: Now you talked earlier you mentioned briefly the idea of robot furniture, but I want to talk a little bit more about it because you've done some interesting experiments, and scenarios where you actually use robot furniture to help people or encourage people to engage with one another in conversation or chessboards where they try to engage you in play. Tell me a little bit about that.

Knight: Sure. We ran an experiment last year that was just presented at a conference this past fall, what we called the Chairbox Chess tournament and basically, it was just a normal chess table on the table but in it, but it wasn't as public atrium around a cafe. And the chairs basically were trying to recruit people to come and play chess. And so, it was the six week experiment in a public space, which is one of my favorite things because rather than bringing people into a lab, and like working with hypothetical's, like if you actually just bring robots into a real world environment, your data is valid, right?

Knight: Like this is the future. What would people do if you put robots in their lives. And so, we had the chairs, like when it was the white's turn, the white chair would try to get people in the black turn and we were pouring different motion strategies and kind of personally robot personalities to persuade people to come to the table. And it turns out that moving back and forth right in front of the table, like just acts like a big old arrow, and like people are like, what do you want?

Knight: Like, "Oh okay, you want me to play chess? Okay cool." Like, whereas like spinning in a circle, people are like, "Are you having fun? Are you dancing?" Like, I don't want to sit on something that's spinning. I don't want to fall on the floor. So spinning is a bad way to get people's attention. But yeah, so, sometimes we explore things through like remote control to try things out. But then once you actually evaluate what works best, you can figure out a really good way to program something in.

Knight: So, with social robotics sometimes, not always, but sometimes the hardest part of the problem is figuring out what will work with people. So we spend time experimenting and then once you actually know the right strategy programming it is easy.

Chitra Ragavan: What's your next avenue of research in the coming weeks and months?

Knight: Well, it is the first week of the term here at Oregon State. So, this is a great question. You know I have like maybe 10 students right now, so we work on different kinds of things. But one of the projects that we've been working on for a couple of years, just at the start of the year is Resolution Bot.

Knight: So by which we mean New Year's resolution, we have this robot and it drives around the robotics building. And anyone that elects you can sign up and it just basically comes to your desk and says, "Hey, would you like, good time for a break?" And they're like, "Sure." "Okay, go do 10 like squats or what do you like to go on a walk or do some jumping jacks." And so it's meant to kind of keep you on your health and nutritional plans. And then when you, after you do your exercise, it has a little basket and offers you like a banana or water. It's just been really like, so I mean the Resolution Bot is that excuse to play with people.

Knight: But the thing that we're really interested in is how do people actually interact with this system? What do they want for it? Then they get used to it over time because it's three weeks long. And so people start building relationship with a robot, and some people like start joking around and so, could we detect that? And so we have the robots sort of follow along with them. So again, we're kind of studying people that make robots that are delightful.

Chitra Ragavan: I could definitely use one of those to help me meet my fitness goals.

Knight: Right? I mean I've been in robotics for a long time, but the having a robot come to my office door it's so exciting. Like I'm like, I mean I, I can't always graduate students this way, but I'm like, "I want every one of your thesis' to involve like filling my life with robots because it's still kind of theoretical for it to be an everyday experience even for me.

Chitra Ragavan: So, this sounds like so much fun, right? We have all of these emotions we're not only attributing to robots but trying to have them convey emotions and all of this, and that's sort of on the fun side.

But I want to go back to the Netflix series, Humans, and it's this fascinating series for those who haven't seen it, about robots the next generation of robots that have emotions, the so-called Synths.

Chitra Ragavan: And the series begins with some fairly benign, episodes of robot assistants entering homes and they look human, they sound human, they feel emotions. But then, you start to have kind of that clash between humans and robots and then things get pretty, pretty serious. So, first of all, I want to ask you, how do you feel about this idea of these kinds of emotional robots that are so like us that eventually it's going to result in a kind of this us versus them event?

Knight: Yeah, I mean, entertainment often uses robots to expose our fears about ourselves. I mean, so like apparently like the Homo sapiens, like killed off the Neanderthals, right? So, there's other versions. I don't know exactly the history. Human evolution is not my specialty. But you know, like the tribalism is something that is very concerning like today across the world and our fears about what one group will do to another or you know, not being included like all the way from like middle school.

Knight: Like it's scary. I mean, and so we're really social creatures and so it always makes for really interesting storytelling. Now, I will say that anyone that actually works in social robotics today across the planet like in recent research like our goal is to make robots that meet human like needs, right? Like we design robots for people. The reason why I study human behavior is that it is easier to teach someone to like be able to point at a location and be like, "Robot, put that there, and it is to teach someone how to program."

Knight: Like that robot operating system. I'll be like, "Okay, now go to this Ross interface and go press this thing and then entered like the coordinates of a location where you would like them to put that place. So, it is very efficient for robots to have some of those things. And if the robot looks sad when it makes a mistake, we are literally more patient with this. My friend Layla Takiyama did this experiment where a robot was just trying to open doors, which is absurdly hard for robots, especially round doorknobs.

Knight: And so, it was just like, it's doing this thing that we find so easy and it's just like, "Are you an idiot?" But when it looks sad, you're like, "Oh, okay. It is hard for you. I'm sorry that I was being mean to you in my head, I'll be a little bit more patient." So, it's sort of interesting how we can use social strategies to help people meet robots where there are, but also help robots meet us where we are so that we can just stay being people when we're interacting with them.

Chitra Ragavan: But do you feel that sort of your efforts and the efforts of others to infuse emotions into robots and make that more social, and they're automatic kind of learning patterns could result in a scenario someday where the lines do get kind of scarily blurry between man and machine?

Knight: I don't think so. But when people ask this question, sometimes I liken this to like, "Are you afraid of your children?" Like, "Are you ever afraid that your children will one day develop the capabilities that you have and that they will want to kill you?" So, if you think about robots as, you know, things that we are like raising like, well... the only case where you would be afraid of your children if you did something really bad, right?

Knight: Like there has been a problem in the development process for that to have happened. And so, I do think it's important for us to think about the future and not presume that things will be well. In the same way a parent has to be responsible and how they raise their kids. We should be thinking about the ways in which we are incorporating technology into society, and so, I think collaborative robotics has a really positive potential to impact over pure automation.

Knight: Like, so the idea of designing a robot just to take someone's job is a very different design perspective than designing a robot that can help people like finish their jobs more easily. Or you know like in hospitals like nurses have all these back problems because they're carrying things like our people are moving them around. So, if a robot could help take away that part of the job that is actually helpful to the nurse and they can focus on their caring behaviors.

Knight: Like I really think that that dynamic of a robot and a person working together to do something is a very powerful one. So, we should think about the ways in which we are integrating robots into society and building technology does not always turn out well. But no, I'm not afraid that robots are going to become the new race that takes over the world.

Chitra Ragavan: Where do you see the field of social robot heading in coming years? What will this decade be like and then the next decade?

Knight: Yeah, that's a really great question. I mean, its funny cause we do get to think in research about, technology that might be like 10 or 20 years out. Whereas, usually in the industry, if it's not a product in two to three years, like then it's just not worth investing in. And that

is one of the reasons why I'm a professor, because social robotics is still a pretty young field.

Knight: So, I mean just figuring out how to do it at all is we're still very early. My entire PhD thesis came from the first two weeks of this acting class that I took in the drama department on movement. I think it was called Movement for Actors. And I literally spent the next three years trying to get a robot to communicate by emotion, in a way that was similar to the first two weeks of that class.

Chitra Ragavan: That's amazingly complicated. Right?

Knight: Yeah, we are complicated. I mean one of the things that I love about what I do, is that I constantly get to kind of bask in the glory of all of the things that we take for granted. Like, just like it's so hard for autonomous cars to actually make sense of the world, and like we can see a path through a forest just because like of how the leaves are slightly more beaten down, even though there's pine needles and rocks, and all these... Our vision systems are absolutely amazing.

Knight: And our ability to kind of, you know, feel like that someone isn't trustworthy like in like 30 seconds or like judge a job interview or decide who to talk to at a party. Like it's very cool what we're capable of, I mean, I don't know if there's life in the extended universe, but like we are very rare and unique and lucky.

Chitra Ragavan: Looking back at your evolution as a person and as a roboticist and your interest in social robotics, do you have any closing thoughts on how all of this work that you've done has influenced your thinking about humanity, humanness, mind to machine communication, human robot interactions and all those deep things?

Knight: Yeah, absolutely. And you know, hammer see nails. But I mean I think that the reason that you know that we exist, the things that really give us our joy are generally relational. I mean, I get a lot of pleasure from my work, but my friendships, my relationships, my children, like the society and community that we build along the way like is I think one of the most valuable parts of our lives. And it's been so fascinating to just sort of understand that if you really want to make a robot that could work with a person, then you have to make them like fun to be around and like you'll get hurt if they don't remember the names of your children?

Knight: I don't know. It depends on like... we use a lot of different metaphors and social robotics. So, if it's your pet, you know who

you would expect certain things or if it's more of a child like robot, or it's more of this, but I mean just there's to any interaction like patients will take their medicine more regularly if they like, if they trust the doctor and they like the doctor, coworkers will be being better at getting stuff done together, when they like each other. And so, the social aspect of our existence is, I think one of the reasons like, you know, life is worth living.

Chitra Ragavan: Heather, fascinating conversation. Thank you so much for joining me today.

Knight: Yeah, thanks for having me.

Chitra Ragavan: Heather Knight is Assistant Professor of Robotics at Oregon State University. Her CHARISMA research group uses methods from entertainment to bootstrap the development of social robots. Dr Knight's interests include playful, social robots, robot ethics, robot theater, charismatic machines and multi-robot, multi-human social interaction. Knight also runs Marilyn Monrobot. A robot theater company with comedy performances and an annual robot film festival.

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