Jodi Forlizzi

An interview conducted by
Peter Asaro
With
Selma Sabanovic

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Peter Asaro: You could just start by telling us where you were born and where you grew up.

Jodi Forlizzi: I was born in Harrisburg, Pennsylvania and that is where I grew up. And I studied illustration as an undergrad in Philadelphia at University of the Arts. And I have a master's degree and a Ph.D. from Carnegie Mellon. My master's is in interaction design, and my Ph.D. is a self-defined Ph.D. in design and HCI. And I have lived in Pennsylvania most of my life, except for period of time in Europe and in Chicago.

Selma Sabanovic: And so could you tell us a little bit about how you got interested or involved with robot?

Jodi Forlizzi: Okay. Well, when I was an art student, I did some work doing technical drawings and things for people at the Penn School of Engineering. And I think that that was kind of a formative experience, because I collaborate with scientists today. So a lot of the form of that work was listening to ideas about subjects ranging from materials engineering to theoretical physics and trying to give it a form. And then when I lived in Chicago, I worked for a consulting firm that did user research for new-product design. And there we did a lot of qualitative and kind of wacky research methods. So I got really interested in researching human activity and product use from a design standpoint, which is really different than sociology or anthropology. There's definitely a focus on how can we improve what we have? So then I was asked to join the faculty at CMU. I was the first designer hired here in the HCI Institute and the School of Computer Science. And there was a project called Nursebot, and Nursebot was a robot that was supposed to help the elderly. And it was a really great forward-thinking project, and it forced the technologists to actually think about how people were going to use the robot. But they really didn't have an idea about how this would work. So we bootstrapped a little four-month project to research how older adults use products and how cognitive and physical breakdowns affected their product use, and that was sort of what launched us into robotics. The first steps with Nursebot were to actually make some practical recommendations about things that were well fixed, at that point, the interface, the face of the robot. The head of the robot cracked. So we made a new head design for it. But from that, we wrote a grant to research broadly applications of robotics for elders and caregivers and we were lucky enough to get a big ITR grant. And so we were on our way, designers and social scientists leading the charge rather than roboticists. So that's a really quick history of how that took place.

Selma Sabanovic: So to go back kind of to the beginning of that story…

Jodi Forlizzi: <chuckles>

Selma Sabanovic: …how did you get the UPenn job or how did you start working with engineers in the first place?

Jodi Forlizzi: Well, somebody I went to school with was working there and they needed people that had basic drawing and photography skills. So somehow I happened into that work. It's very happenstance. Somebody works there who needs somebody else. So that's what we did, and then it evolved into a really interesting situation. I had a lot of interesting collaborations with people that were very fascinating. The person writing the theoretical physics textbook would sit by my computer with me, and we would just talk about ideas. And I think that was really a very interesting experience and a very formative one.

Peter Asaro: Prior to the Nursebot, did you have a preexisting kind of interest in robotics at all?

Jodi Forlizzi: <whispers> No.

Peter Asaro: And…

Jodi Forlizzi: Not at all <laughs>.

Peter Asaro: …was there anything about robots, at that point, that really attracted you to that project?

Jodi Forlizzi: Well, I think as a interaction designer social robots are really interesting because it's a not-well-defined territory. So in graphic design and even industrial design, there are well-defined conventions, Web design, for how to handle interaction. But in a social robot that has social and humanlike cues, there isn't at all. So it's a really rich design problem, and I think that's what made me interested. Also, when you have things that can sense and actuate, it's a very different design situation than designing a poster for example. So it's an exciting territory for designers.

Peter Asaro: Have you done three-dimensional design before?

Jodi Forlizzi: A little bit. But primarily Web design and communication design. So some product and interface design.

Selma Sabanovic: And so did your interest in interaction design coincide with the robots or was prior to the robo –?

Jodi Forlizzi: Oh, I had my degree in interaction design. And our big project that we worked on, which was really forward thinking at that time – you'll laugh now. But we made this hiking stick that had a GPS, and it was powered by a battery that charged as you walked. And Apple used to have this student competition and our team of grads and undergrad students from CMU actually won this competition. And we got to go to Interval and Apple and see what they were doing and see the forward-moving research that they were doing at Interval at the time. So it's actually really interesting. So, no, I don't think there was a lot of robotics. Design was just beginning to cross into technology. So at that time, at CMU, they had just gotten the Andrew mail system interface designed. And ATMs were the hot thing. It was way before people were making social robots.

Selma Sabanovic: So how was it being the first designer in the HCI school?

Jodi Forlizzi: <chuckles>

Selma Sabanovic: <laughs>

Jodi Forlizzi: Yeah, it was about a couple years' of crisis mode and doing a lot of proselytizing about design. And, actually, we did a lot of research to explain to our technology and social science collaborators about how design research is different but equally as valid as scientific or human science research. And we came up with something we called research through design, which is, when we design things, naturally, what designers do. But we codify understanding. We draw out knowledge through what we design. So we created this narrative about how we worked, which was successful. And then directly collaborating with people was also a really good experience for them. Then they understood how design worked beyond just making an interface at the end. Coming in after the technology was designed. And I heard people say things like rather than just evaluate what exists, we can imagine what might be and design it. And that was kind of exciting. So with our research on elders and products, we came up with five areas in which robotic technology could assist older adults. And they were health and wellness, which included medicine management, I'm going to forget all five, favorite place, so a lot of times when people start to decline they spend a lot of time in the same chair, social and emotional support and there were two other ones, which I'm drawing a blank on. We can stop the tape and I can find out what they are. But we designed a couple of product concepts based on that. One is this product, the Hug, which the stuffed model is there. And that was a teleconnected-communication device that you could actually touch and it would warm and you could squeeze it and receive a signal from somebody far away. Then we designed a chair called the SenseChair, which basically provided awareness or support or actually did tasks for people who were pretty much chairbound. So that was a really neat time in the research, because we weren't actually designing robots. Although we did make the technology for those things, they

were fairly simple. But we were showing the robotics technology what could be when you deeply consider the needs of users.

Selma Sabanovic: Who were some of your first collaborators here?

Jodi Forlizzi: In robotics, Reid Simmons. And I work with Sidd Srinivasa now on the HERB robot, that's a more recent collaboration, Paul Rybski. I've actually collaborated with Howie Choset a little, he does search and rescue robots, Manuela Veloso. Those are some of the people that I've worked with, but Reid was the first person.

Selma Sabanovic: And how did that collaboration develop?

Jodi Forlizzi: Well, we coadvised a student. So that's a really good way to get you face to face in a room with somebody every week. And there was this period of research funding where we got these large collaborative grants. So we had the opportunity to put technologists and human scientists and designers together. So that was a really opportune time for doing research.

Selma Sabanovic: And what were some of the challenges of doing that kind of research and also some of the things that you learned that were different from having to…

Jodi Forlizzi: Yeah, one thing I learned is that not everybody has the same uptake about skills that are not science based. So people can be very willing to work along with you and accept your ideas and accept that you are marching along in the process and asking just different questions or they may not. <laughs> In those cases, it can be harder to say, no, this is what people need, we're not going to make this technology just because it's advanced technology. So one of the important learnings about design is that you want to look at the system holistically, which means that you may not be using the latest technology, you might be using something simpler in support of the overall goal of the system. So that, I think, is a hard thing for people who are traditionally doing cutting-edge robotics and science research to accept sometimes. So I think that's one of the difficulties.

Selma Sabanovic: And what are some of the projects? You mentioned the Hug. You also mentioned the Nursebot. What kinds of things were you looking at in those projects, and what other projects did you work on together?

Jodi Forlizzi: Yeah, so with Nursebot, our primary effort was to redesign this head. So along with my then student, at the time, Carl DiSalvo, and Francine Gemperle, who is a staff member here, we did research on the design of a robot head. And we came up with design

recommendations for how to make a robot seem humanlike and friendly, and we did that by looking at a lot of examples and measuring them and doing a survey with people and coding these robots for the presence and absence of features. And then, from that work, we designed this new head for Pearl, which could vary the width and the heighth of the head, the perceived size of the eyes and the perceived distance between the eyes. And we used that for a lot of studies.

So a lot of times, in design research, you're not designing a product that's going to go to market. You're designing something that becomes another research prototype and more questions and answers. We did the Hug, and we did the SenseChair. And we actually iterated on the sensor design for the chair. We started with a Tekscan sensor and reduced that down to 12 sensors that had roughly the same accuracy in recognizing a position. So if somebody's sitting like this or leaning forward or leaning back, we can deliver a different kind of signal. So that was a nice piece of technology research that spun off of that. And then we had a period of research where we looked at systems in the world, like the Roomba. And we looked at two hospital robots, the Aethon TUG and the Pyxis HelpMate, which doesn't exist anymore I think. It may exist as something else. So we did research in the hospital to understand how different members of an organization would make sense of that technology. We did some of that with Nursebot, too, although it was a little canned because Nursebot never really richly helped people.

And some of the interesting things we learned from that work is that, even in one organization, different groups within an organization can have drastically different responses to the robot. So in studying the Aethon TUG, for example, which I did with my then student, Bilge Mutlu, who's now at Wisconsin, we studied the robot in two exact same layouts in the hospital. One was a cancer ward, and one was a postpartum ward. And in the postpartum ward, people loved the robot. They found it was really social, and they wanted to dress it up and change the voice to be a singer that they liked. But in the cancer ward, people hated the robot. They cursed at it, pushed it and called it names because they felt that it interfered with their critical work of caring for the patients. So that was a really interesting piece of knowledge that showed that even within one hospital the design of the robot may need to vary to better suit the kinds of work that are going on within the setting. So that was kind of fun. And the Roomba work was fun, because always doing research in the home is really fun. That's one of my favorite places to do research. And then about four years ago, we decided that we wanted to build our own robot that we could research in our own setting, with our own materials. And so we started working on Snackbot, which is a robot that is supposed to deliver snacks, in our building, at CMU. We are finally running the robot, and we're going to start piloting that in January. So we developed a snack-delivery service, this robot. And we have a lot of interesting research questions, like do people change their behavior when they think a robot knows whether they're taking an apple or a cookie? So we can do lots of research on people's healthy-snack choices, how modifications of the design might change that and how people interact with robots over time, also how robots should interrupt people. So if it came to the door right now, what would it do? So those are some of the things that we're interested in right now.

Peter Asaro: So you mentioned some principles you've learned in the previous projects. But I wonder if there's, sort of in the field of human-robot interaction, if there's some really key concepts or principles or breakthroughs that you've had over the years.

Jodi Forlizzi: Oh, that's a good question. And I don't have an answer for it <laughs>.

Selma Sabanovic: <laughs>

Jodi Forlizzi: I think overall we need to make sure that the technology suits people's social, emotional and educational goals. So I mentioned that we had been working with the HERB robot. This is a Segway base with two arms. It's very similar to the PR2 robot that's been developed by Willow Garage, and this is supposed to be a fully-autonomous robot that carries things and open doors for people and possibly can feed people. And this summer, we had a wonderful opportunity to work with a man who had a spinal-cord injury. And he's 20, and he had been a daredevil. He had all these sports cars and a motocross bike and, actually, he had a motocross accident and that's what caused his paralysis. And so we worked with him this summer to understand how he would want to use this robot. And one of the things we learned is he does not want a fully-autonomous system. He wants something he can tinker with and show off and customize, and that was a really stark moment where we realized that everybody has social goals and educational goals even if they have very limited use of their body. So I would say that's one overarching principle. And a lot of times, in technology development, we forget that. And as a result, the technology can be stigmatizing or intimidating or embarrassing to use. And I think we need to keep those human values in mind.

Selma Sabanovic: When you started working on the Nursebot, was it already partially designed before you started working on it?

Jodi Forlizzi: Yes, it was all designed <laughs>.

Selma Sabanovic: Okay. So why did the head become the main focus of that…?

Jodi Forlizzi: It cracked.

Selma Sabanovic: …<chuckles>? Oh, okay, it's just the <laughs>…

Jodi Forlizzi: I mean these systems are still craft. They're one-offs. So, especially with Nursebot, it was very frail. Motors were constantly burning out. They had to redesign things

and add it to the head. The head cracked. So when the head cracked, they said, okay, we've got to get the designers involved. So that was our opportunity to really begin working with them. So, yeah, was largely finished when we got there. And then, over time, they added screens and different things. And, yeah, it's kind of a mishmash. It's somewhere around here <laughs>.

Selma Sabanovic: So how is the Snackbot different? Because that sounds like one of the first systems that was designed from this more human-centered perspective and where you could kind of have input in what it's going to look like and what it's going to do from the very beginnings.

Jodi Forlizzi: Yeah, so, this time, we approached it with overarching-design goals. What is the robot going to do? What is the character of the robot? What kinds of people will be interacting with it? How do we want it to communicate as a system? So rather than coming in at the end because somebody has this rich idea about AI or vision, we've said, okay, these are our design goals and every decision we make, in terms of form, hardware, software, interaction, is going to support these goals. So it was quite different. So, for example, Snackbot uses a fairly simple navigation. It works as a plan of the building and then some sensors and cameras that are onboard. For a while, we thought we would build our own base. But then we just used a SICK laser, because rich navigation is not the overarching goal of the robot. It's to be social and function in an environment. So that's an example where, using those design goals, we made a tradeoff in what technology we would use. Similarly, Snackbot doesn't have operative arms because while we would like to have that, from an interaction standpoint, it's far too complex. So it has a tray with sensors, which can record what people's behavior is doing.

Peter Asaro: When you first started working on, say, Nursebot, were there other robots you looked to, other robot designs, people you looked to? Or did you mostly draw on design theory?

Jodi Forlizzi: Oh, no, we looked at lots of things. We had several undergrads. Actually, a huge team of people have worked on Snackbot. And we did kind of a competitive analysis of the humanoid and social robots. I mean, there's a lot of beautiful robots in Japan for example. There's commercial robots, just really beautiful forms to take a look at. And we look at all those. And then, along the way, we test our designs in terms of form. We test sketches on paper. We test quarter-scale and half-scale and full-scale models. So we're always trying to evaluate along the way. It's never a process where we don't get people involved, because it's pretty critical I think.

Selma Sabanovic: You also worked with the Roboceptionist <laughs>. How was that? That one's been interacting…

Jodi Forlizzi: <starts to laugh>

Selma Sabanovic: …with people for a long time.

Jodi Forlizzi: Yeah, so that's another robot which was pretty much conceived of before I came to the group and so our work with the Roboceptionist took the form of making recommendations about how to make it interact more fluidly, so, for example, shortening the length of time that the robot speaks so people don't get bored or distracted or walk away. And then we study the data from the robot quite a bit. So one of the things we did was we looked w – so you type to interact with that robot. So we looked at whether people greeted the robot with a social greeting. And using that simple measure, we could determine whether people framed the technology as social or as a machine using this cultural-model research that we found in service design. So it's really interesting, because it suggests that even if we know something simple about somebody's behavior when interacting with a robot, we can change the design to better support their sense of the technology. So I really like that work, and we've applied that in some other areas of our research. So I think it's pretty promising. But, Roboceptionist, I didn't have a lot to do with the design of it. Also, it was largely created by the time I got there. One of my then graduate students, Rachel Kirby, who's now at Google, developed an emotional model for the robot. And then she tested whether people could see that the robot was sad, was moody. And people could tell the difference. So, again, we are – there's so many design variables that we can test and see how people respond to them. That's why it's really fun to work with robots.

Selma Sabanovic: So what are some of the insights that, particularly, work on robots brings into design? So we talked about how design can inform the robots. And so what do you think?

Jodi Forlizzi: Yeah, well, I think, in the most broad and abstract level, it's not a one-way communication. If you design a poster, somebody looks at it. The poster doesn't respond. And, similarly, we don't usually go, "Hey, I've laid this poster out. How's it reading?" We don't test those things, because we have well-developed conventions for how to design them. With the robots, it's much more complex and many more factors are coming into play. So it brings to bear different aspects of how designers work. So you need to work in a team. It's interdisciplinary. It's more collaborative. There's a two-way signal. We're sensing and actuating. So there's many, many more conditions to control. And then I think another thing is that we can think about what the robot provides as a service, and so service design is becoming an interesting place that is merging with social robots and human-robot interaction. And some of our work has done that recently.

Selma Sabanovic: In terms of the interdisciplinary collaboration, how have you experienced that through the years? Can you see changes since people have been working together?

Jodi Forlizzi: Yeah, I do.

Selma Sabanovic: <laughs>

Jodi Forlizzi: I see much more of an uptake of design methodology and design inquiry, and one of the things we've tried to do is to broadly teach people how to frame their research with a design approach. So you don't have to be a designer. You don't have to be collaborating with a designer, but you can ask design questions. So I think that's an important part of the training of our Ph.D. students in HCI, and we do get some robotic students who train in that as well. I think the, for people who are uninitiated, the pure experience of working with a designer is really good. Because they begin to see how that type of thinking, making, concern for human values can affect the work. So I think overall it's kind of soaked in. And I can't point to any specific evidence and say this is a robot that came out of design…

Selma Sabanovic: <laughs>

Jodi Forlizzi: …knowledge, but I think it's happening.

Selma Sabanovic: Well, it's a general feeling. So reflects on the kinds…

Jodi Forlizzi: I hope so, yeah.

Selma Sabanovic: Well, it's a general feeling and all, so reflect on the kinds of products and research. <laughs>

Jodi Forlizzi: I hope so.

Selma Sabanovic: You were also there at the very beginnings of the construction of the human robot interaction community, so could you tell us a little bit about that and some of the early days and how people got together?

Jodi Forlizzi: Well, I think my colleague, Sara Kiesler, is really the person to speak to about that.

Selma Sabanovic: We'll talk to her tomorrow.

Jodi Forlizzi: Good. She was very good at seeing the conditions for this new field, and at first people were writing these papers and there was really no place to publish them. Like some

appeared at KI and our paper about the head design was at Designing Interactive Systems. And Sara really saw a need for a conference so she started the ACM Conference in human robot interaction, which I think is a really rigorous, good conference, particularly with behavioral studies. A journal was started. And then another thing that Sara and I did along with Pam Hinds at Stanford is we had a young researcher's workshop. So we received some funding and we thought, oh, you know, we could just get this handful of people together that are leading this research in HRI or we could get students, and that was a really wonderful experience because I think these are the people that are really going to see the field, and they've created a cohort and many of them are in their first jobs or first postdocs and coming out, so I think that workshop was fantastic. That was a really good experience, and we have Sara to thank a lot for that. She knew what to do. <laughs>

Selma Sabanovic: So you mentioned Sara and Pam. Who were some of the other people that were there in the beginning?

Jodi Forlizzi: Well, obviously the people from ATR, <laughs> who I hope you're talking to. And Maja Matarić at USC and also Cynthia Breazeal, of course, is really, really, really well known for her work. I'm sure I'm going to miss people. Reid Simmons and – Cliff Nass did some work and his student Leila Takayama who now works at Willow Garage. Then there's kind of I would describe a core of people who are central to social robots and then there's maybe a second circle where people are working on problems that are critical to HRI like navigation and path planning, and those would be people like Sidd Srinivasa and Reid and the guy at Stanford, Oussama Khatib, is that his name? And then obviously Sebastian, although he's passed through to another kind of research. And then there's another kind of in that second ring people who are working on rehabilitation robots and other kind of specialties where you do interact closely with humans. So it would be fun to try to map that –and I guess you will –you know, who's kind of in the center. And I think I have the New Yorker's view of New York, right? Like I'm looking at the human-centered people in the middle but maybe somebody else would do that differently, so it would be neat to try to do that.

Selma Sabanovic: And what were some of the early reactions to HRI research both from the technical group, from people who would have a more technical perspective but also these other venues that you mentioned like TIS or the KI conference?

Jodi Forlizzi: You know, I think it's very – people are intrigued by it because we as a society, as a world have a fascination with robots. We are so shaped by the views of media and culture in looking at these things and thinking about them, but I'm sure there's people that believe it's a trend and a fad. So there's probably people that appreciate the research and people that think it's not timely, and I think that begs a larger question of how do we view what is good research, and I think there's a lot of different opinions about that.

Selma Sabanovic: And do you see that that's changing, in a sense, so even thinking about the kinds of responses that people have had to your research through the years in these different venues and the kinds of spaces that you go to talk or the people that you discuss these things with?

Jodi Forlizzi: I think HCI and robotics is realizing that HRI is here to stay, and there are some signs of that. For example, I just got asked to be on the committee of a pretty technical robotics conference because they want to have HRI papers, or you get asked to speak how you see things in the press. You know, I think these things feed back as signs that the research is important and valid. I got tenure, so <laughs> I guess they thought it was important and valid at CMU. So I think there are signs that say overall it's pretty positive, yeah.

<crew talk>

Selma Sabanovic: About the HRI workshopstuff that you were talking about and that was quite an amazing experience –

Jodi Forlizzi: It was really fun.

Selma Sabanovic: – I think for everyone involved –

Jodi Forlizzi: It was a lot of fun.

Selma Sabanovic: – including the fact that from our perspective from what we talked about it was such a posh hotel. <laughs>

Jodi Forlizzi: Oh, it was amazing. You should track what all those people are doing. I think it would be really interesting. Most of them are in productive careers.

Selma Sabanovic: Yeah. No, definitely, and I mean it certainly really created I think a community of scholars, just even putting them in this really beautiful hotel where you get your beds made up and every morning they put a little –

Jodi Forlizzi: A chocolate is there.

Selma Sabanovic: – chocolate. <laughs> We were all shocked.

Jodi Forlizzi: And they have these ancient beautiful gardens. It was amazing.

Selma Sabanovic: Yeah, as grad students we were all kind of shocked and <laughs> very appreciative.

Jodi Forlizzi: <laughs> You have Pam to thank for that. We would've been in a Best Western if I had had to find a place, but she kind of knew about that place, so it was really, really nice.

Selma Sabanovic: So how did you get into a working relationship with Pam?

Jodi Forlizzi: Pam was Sara's student, so Sara brought us together.

<brief interruption>

Selma Sabanovic: Wait. I forgot where we got to.

Jodi Forlizzi: Pam. You asked about Pam.

Selma Sabanovic: There were Pam, Sara, HRI...

Jodi Forlizzi: Oh, the students at the workshop, following the people at the workshop.

Selma Sabanovic: And so how have you seen HRI develop? I mean it hasn't been very, very long, but through the years that the conference has been going on and the research has been going on what kind of –

Jodi Forlizzi: Well, I think we are seeing study of human robot interaction and new outposts, so for example, Bilge, my former student, is now doing work at Wisconsin. They're kind of starting a new HCI/HRI lab, so we're seeing more evidence of that. There's funding one of the missions of the National Science Foundation and the human-centered computing thrust is to have human robot interaction research. Drexel University is another new place where robotics is happening. And then I think that the output of the technology and the things that we're learning is creeping closer to products in the market, so particularly in home healthcare, and then there's cleaning robots. So I think it's expanding slowly. And, again, I think there are small things we can point to, which overall says looking good, you know. Things are looking positive.

Selma Sabanovic: What do you think are some of the challenges of doing this, particularly in things like service robotics, which are so different from the previous focus of robotics on environments that are perhaps more controlled and don't have as much intimate or social contact with people? What do you see as some of the challenges?

Jodi Forlizzi: Well, I think finding the sweet spot in terms of places to do the research. I mean we're very, very lucky that we exist in a robotics institute where we have a lot of people who can develop the technology. I think having companies like Willow Garage and their system and their open platform is wonderful because it makes the ability to do that research much easier for people. So I think facilities and location is an issue. Money obviously is an issue. I spoke of those ITR grants. They were million-dollar grants, and it was easy to have three, four, five faculty. Now you're lucky if you get a grant for 300K, and that's a couple of students and maybe a little bit of a couple of faculty. So I think that the funding is one of the big challenges, the ability to do that. So I think it's hurting the progression of the field a little bit.

Selma Sabanovic: So you mentioned getting funding from NSF. What other places?

Jodi Forlizzi: I've gotten funding from Microsoft. We've tried for NIH money but we haven't gotten it. We obviously have money from Intel because we work with the HERB robot. That's basically it for me in terms of robotics.

Selma Sabanovic: In terms of the funding that comes from companies what kinds of things do you see them as being interested in?

Jodi Forlizzi: Well, for a company like Microsoft or Google they might be just doing basic research in the area, so a really interesting example is Google's research on autonomous driving. You know, they're not going to marketing a car anytime soon, I don't think, but they have a hand in that research. They're interested in progressing the field. Same with Microsoft. And then companies like Sony may be quietly working on home robotics under wraps. But with the current economy it's very hard to get a lot of funding from a company. They might give a one-time disbursement, but you're not going to get enough money to pay for a Ph.D. student for five years, so it's kind of a problem. And then more recently service design has become a productive angle for funding, so right now I have a proposal with the local hospital here who's interested, and then there are some other companies that make like mixing robots for medication, and they may be interested. But then those are not really working directly with people. And, oh, there's the military. <laughs> And I have a little bit – I'm on a huge grant with Manuela, Howie, people from USC, MIT, Penn. It's like cast of thousands. I have a very small part in that research, but I suppose there's military research money. It's just something I personally haven't deeply investigated. It's a different kind of work.

Selma Sabanovic: And what is the research with Howie and Manuela?

Jodi Forlizzi: It's multi-robot planning and my task is to understand the social and cognitive outcomes of these system. So we spend some time working with the HERB robot looking at how robots should hand off items to people, and now we're looking at interfaces for multi-robot control. So I originally said I would research how an emergency team would collaborate, but it's been really hard to get to the right kind of people, so we're just kind of doing these other activities. But I think the multi-robot control will be an interesting problem to work on, so starting to think about that.

Selma Sabanovic: So in terms of the service robots, the robots that are out in the world, there have been some attempts to make products, but some of them have been kind of pulled back, so like the AIBO or QRIO that never was really sold or NEC has PaPeRo that is kind of always –

Jodi Forlizzi: I love that robot!

Selma Sabanovic: I know!

<laughter>

Selma Sabanovic: I want one.

Jodi Forlizzi: I do, too!

<laughter>

Selma Sabanovic: So how do you see the potential switch of these things into products? Do you think that there's a possibility of having them out there as a Snackbot or as something like that, or is it going to be some other –?

Jodi Forlizzi: Well, I think we as a U.S. population are not ready. Our homes are not really designed to have big pieces of mobile technology in them. We don't have power, and we have clutter and rugs with fringes and curtains that fall down on the floor, so contextually I think some things have to change. And then in terms of the products I'm not sure that people have found the sweet spot yet. So, for example, with the Roomba and the Scooba, which are cleaning robots, fantastic. If you can't bend or push a vacuum this could be a great product. But, oh, in reality it needs a lot of babysitting because it still doesn't have a good algorithm for cleaning, and it's

going to stop and beep and you can't really just put it down and let it go. So I think there's a number of reasons why we're not seeing a lot of robotic products on the market just yet. But then there's a lot of products that have sensors, which work very effectively, and so depending on how you define a robot you can say that these things are successfully coming into the market. But a moving social thing, not yet.

Selma Sabanovic: But when you did your research your Roomba research had some really interesting results. Could you just tell us a little bit about those? <laughs>

Jodi Forlizzi: Yeah, so the overall framing of the research with the Roomba was we studied how elders and young adults cleaned, and then after we had a good sense of that we introduced either a Roomba, robotic vacuum, or a stick vacuum, which functionally did the same thing. It was about the same suction power. It went under stuff, but you had to push it. And then we followed up with these families for a year to see if how they cleaned changed. And with the robotic vacuum cleaning definitely changed. They changed how they cleaned, how often they cleaned, who did the cleaning and what other products were used, and so that was really interesting. And then there was a lot of findings about social descriptions about the future, so how it looked, how it operated, how people made sense of it. So it was a really fun study to follow up on these families for a year.

Selma Sabanovic: And did you think there were some interesting ways of potentially using this human aptitude to socialize things that are primarily functional, really, in terms of the design?

Jodi Forlizzi: Yeah, I think people socialize things a lot. I mean all the time you hear of people naming their cars and things like that and then there's other research about how if you have a Dyson vacuum men are more likely to clean because it's a more interesting gadget. So some of these things I think we can leverage in terms of product design. As I said, I just don't think all the factors have come together yet, but I bet within the next few years there will be some successful home robot.

Selma Sabanovic: And how often do you see the kinds of things that you find in your research ending up in some of the robots around here?

Jodi Forlizzi: Around CMU?

Selma Sabanovic: Around CMU, or actually it doesn't have to be around CMU, just in any system.

Jodi Forlizzi: Well, I'm happy to report that there's been a whole litany of hugging-type robots <laughs> from art school projects to therapy buddies to <laughs> other researchers at other universities making these things. There's teddy bears. So that's a fun thing to kind of track, the Hug and its grandchildren. You know, the sensors in the chair is a really viable area of research and could be used in driving applications, for bedsores, for people who sit in wheelchairs, so I think that's another piece that's come through. And, well, there's a few snack deliverers out there, too. So <laughs> I guess in application there have been some things. We've designed the housings for two robots now, Snackbot and HERB. HERB is getting a new housing that nobody has seen yet because it's in production, so I don't think the visual form language has translated yet, but maybe we'll have robots that look like ours, too.

Peter Asaro: What were the biggest challenges in the Hug robot?

Jodi Forlizzi: Well, people made fun of it because it purrs and it gets warm, <laughs> and you can think about all the things that you might associate with something that you hold or sit on. And I think we didn't really deeply research the form. I mean it was more of a kind of cultural probe where you put something out in the world to see how people respond to it. That red pillow there, which is on top of that noisy refrigerator is actually one of the alternative shapes for the Hug, and that one people actually really liked because you could use it as a pillow. You could squeeze the ends of it. You could imagine having the control in the corner. So I think were we to really get vested in that we could pick up and do some more research about what the form would be. Older people in particular have a great concern for what's in their home, and especially as they move to a smaller home what stays there is really important and how it looks and how it fits with the decor, so these are really critical questions when designing a robot for a home.

Selma Sabanovic: You've also been part of this large quality of life grant at CMU, right?

Jodi Forlizzi: Yeah.

Selma Sabanovic: Who else is in that and what kinds of projects have you been working on as part of that?

Jodi Forlizzi: Well, our work with HERB all falls under quality of life, and some of the other roboticists are Manuela, and she has CoBot, which is a rapid rolling robot that does something. I don't know what. And Paul Rybski is on the QoLT [Quality of Life Technology Center] project and also Reid Simmons, so I'm naming the same names. Oh, and then there's some people at Pitt. There's Rory Cooper. He works on a wheelchair with arms. So there's a robotics thrust, and I forget what it's called because it was a new name, but it used to be called mobile and

manipulation robots. But the overall goal of that grant is to improve the quality of life for people with disabilities and elderly adults, and this is the sixth year of the grant, and there's a lot of faculty, maybe 30 or 35 faculty working under this grant. And so the desire of the NSF is to have more integrative work, and they point to HRI as an example of how people could integrate their systems holistically, so that's what we're trying to do right now, so we'll see.

Selma Sabanovic: And how does that look like on the ground?

Jodi Forlizzi: Looks like herding cats.

<laughter>

Jodi Forlizzi: It's impossible. Because I don't know, but the way it is at Carnegie Mellon is it's very much a fiefdom. We are all seeking our own research money, so I could have the best ideas for collaborating with somebody, but if I don't have any common students or funding it's going to be really hard to do that, so I think that's one of the limitations of the work. So we're used to working that way, and then we have this umbrella project like QoLT. It's quite difficult for faculty to move within that, but it seems to be working well. Within the robotics area they've asked the Pitt people to collaborate more closely with the CMU people, so we might see that happen this year. And I know myself the experience of working with the spinal cord injury person was fantastic, and Sara and I wrote another proposal to try to extend that work, so I hope we get to do that. But that won't be a QoLT. That'll be our own thing.

Selma Sabanovic: And so you mentioned before that students have been very instrumental in terms of getting collaboration among faculty going. Is that once again the case?

Jodi Forlizzi: Yes. In the HCI and robotics Ph.D. program students can have more than one advisor, so it's a really wonderful experience to be collaborating with a student and then another faculty who has a different background than you, so we'll be looking at the same research problem with a very different set of lenses and progressing research in the field in a really great way. And my students who have worked in robotic applications have all done phenomenal work, really integrative work that combines things from different disciplines, and it's been a wonderful experience, so I'm really glad that we have that. If we just had the faculty left to do that on their own it would never happen because people are too busy and we're siloed. And I think the generation of people who are getting trained now are true hybrid people. They can look at problems with different perspective simultaneously, and that's really good.

Selma Sabanovic: What are some of the things that you're interested in for the near and far future?

Jodi Forlizzi: Uh-huh. I'm really interested in service design. I think that that's an interesting area that will cover how we make sense of technology, can be researched fluidly, can give clues about design and how technology should be designed, so that's something that I'm really interested in. I'm also pretty psyched about doing more research that integrates the assistive technology or rehab technology, which would be designed specifically for one person and then technology for all, which is like a grip that's easy to handle. So can we move from these one off designs that helps this particular person to something generalizable, which can help a lot of people? And lots of researchers are talking about this now like DIY, rehab technology, and it will be interesting to see how the field progresses, but that's some things that I'm interested in, too. And then I think a third thing that I'm interested in is how people become engaged with an interactive thing, and what we can learn from that in terms of human behavior and apply it to design, so those are three things that I'm kind of interested in right now.

Selma Sabanovic: And it seems since having a robot that interacts with people who are total non-experts in robotics poses different types of challenges. How do you think that's informed some of the designs or some of the things that robotics is looking at now or HRI is looking at now?

Jodi Forlizzi: Well, helping populations like older adults or people with disabilities, these may be people that have never had a chance to interact with this technology. And furthermore a person with a disability may have had a full life before an accident, so it creates a really interesting situation about how people approach, use and make sense of technology. It can't be stigmatizing. It has to support what they value and communicate the right things. And those are a lot of situations that we've only begun to consider, so I think it's a ripe time for the field.

Selma Sabanovic: And just one more thing. One thing that you talk about is the difference between this initial interaction with something like a robot and then what happens afterwards once you've gotten used to it. So do you think that that's also going to start changing some of the questions as people actually start interacting with these things? So now they have them in hospitals, for example.

Jodi Forlizzi: I hope so. You know, I hope it changes culturally. I mean you can think about radio as a really interesting analogy. So back in the day there were just Ham radio operators and then there was radio for everybody and it was kind of free and available. And then there was advertising and then it changed. So I think this is probably an area of your expertise. We can study the development of other kinds of technology and see how it has affected and changed the world. I love the history of appliances, for example, because appliances were supposed to save people time, but in the end it just made us able to do more things because we could do wash and have clean, sanitary countertops and the refrigerator that kept things cold. And instead of doing

a few things we then ran the whole household, so I think it's a really interesting – many ways to look at it.