

## Industry Corner

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In this “Industry Corner” column, we interview Dr. Leila A. Takayama who holds positions at Robust.AI—a company deploying robots with a human-centric design and AI-powered workflows—and Hoku Labs, a consulting company specializing in human-robot interaction research.



Leila Takayama is a Human-Robot Interaction specialist in the psychology of people's interactions with robotic products and services. She is VP of Design and Human-Robot Interaction at Robust.AI, where they are developing collaborative mobile robots that support warehouse operations. Prior to joining Robust.AI, she was a tenured associate professor at the University of California, Santa Cruz. She also worked as a full-time researcher at Willow Garage and GoogleX.

In this interview, Dr. [Takayama](#) will give us a view of Human-Robot Interaction (HRI) in the psychology of people's interactions with robotic products and services, provide some open research problems, and how academia-university partnerships can help tackle these challenges. The interview concludes with advice for young researchers wishing to enter the field and what topics/skills are needed. We hope you enjoy it!

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***1. Could you share a bit about your background and how you found yourself working in the field of Human-Robot Interaction (HRI)? What aspects of this area do you find most fascinating and ground breaking?***

I'm a social scientist by training, who caught the human-computer interaction (HCI) bug early in college. I always felt guilty about boring our Cognitive Psychology research study participants in the lab so it was a relief to find out that I could do more engaging research in Computer Science. Thanks to James Landay and his PhD students, I got a taste of how I could use my research methods and theories in the service of making computing systems more useful and usable for end-users. I'd never planned on going to graduate school until I did undergraduate research with them. In my graduate studies, advised by Clifford Nass, I got to expand the scope of my research to include driving simulators, ubiquitous computing prototypes, and toy robots (e.g., Legos). I got frustrated with being limited to toy robots so I snuck into the Stanford Computer Science career fair to approach a robotics company about buying a robot from them for our lab. That company had a weird and intriguing name: Willow Garage. To make that long story short, I stumbled into robotics through working at Willow Garage for more than a few years. That's where I really dove into human-robot interaction (HRI), which is a fascinating field for at least a couple of reasons:

- (1) People respond in such a visceral way to robots, which is fascinating to observe. What they say they will do vs. what they actually do when faced with a robot tends to be quite different. My robotics engineering friends tend to treat humans as noise in their models of the world. I can see why, but I also see huge opportunities for making some sense of that noise so that we might build more useful and usable robots.

- (2) Robotics is decades behind computing when it comes to human factors and user-centered design, which means there's much more room for improvement. There is no dominant design in robotics, the way that there is a dominant design in, for example, mobile phone or tablet design. We're still inventing this future.

***2. Please tell us a bit more about Hoku Labs and ROBUST.AI and how they are helping push HRI research in directions others have overlooked.***

Robust.AI is a physical AI company that is changing mobile robotics in logistics and manufacturing. Our team takes a human-centered approach to the design and deployment of mobile robots that provide quantitatively measurable value to customers, e.g., improving the efficiency of warehouse picking operations. We launched our flagship product, Carter, which looks like a simple pushcart, but it's actually a fully autonomous and collaborative robot that works with warehouse workers. It reduces unnecessary walking and makes it easier for pickers to find items on warehouse shelves, improving their efficiency and accuracy. Carter is even easier to maneuver than their passive pushcarts, thanks to its force sensing handlebar, holonomic base, and obstacle avoidance system. Robust.AI is leveraging HRI research to make warehouse workers superhuman, demonstrating how human-robot collaboration performs better than people or robots.

Hoku Labs is my consulting company, which I founded after I left Google X and before I joined the faculty at UC Santa Cruz. Through my Hoku Labs work, I help my friends and colleagues to translate HRI insights into actionable design directions and immediate next steps for their robot products and services (e.g., autonomous cars, consumer drones, hospitality service robots, telepresence systems, ocean robots). This is translational HRI research, drawing from the concepts and theories of more basic HRI research and figuring out ways to apply them to robots that are being deployed in the near future. In academia, we work so hard to publish research papers, but it's unfortunately very rare for folks in industry to pick up and use those research findings. At Hoku Labs, I'm trying to bridge that gap so that people building and deploying robots today make fewer foreseeable mistakes and move in more productive design directions faster.

***3. Which, would you say, are the hottest research topics within HRI, today and for the next five years? Can you give some examples of some open research problems?***

HRI is such a relatively young field so it's still the Wild West for us. There is no shortage of hot research topics to be tackled and there are not enough of us to nearly begin to cover them all. I can't speak for our entire field, but I personally see more than a few exciting research challenges:

- (1) How might we enable a **broader set of users to operate robots**? I've been lucky to collaborate with professional robot operators of flying drones, forklifts in warehouses, deep sea systems, bimanual manipulation platforms, and more. They have special skills, which are hard to find and often hard to train. There are some fundamental interaction design challenges for HRI, which many researchers in our community are working on, but we are far from having solved this problem.

- (2) How might we leverage the current advances in machine learning to drive robot learning? A particularly juicy research challenge for HRI research is figuring out **how to make robots more teachable by end-users**, not just teachable by roboticists or ML researchers, who are good at prompt engineering. How could/should robots ask for help and feedback from people, who know better than the robots do?
- (3) Which **robot forms** are “best” for the rich diversity of contexts, where people actually want to use them? I do not believe that humanoids are going to be the right answer for all contexts everywhere. They might be perfect for some applications (e.g., entertainment in theme parks), but we have much more design exploration to do. There are some intriguing HRI research projects out there now that are expanding this design space.
- (4) How might we develop **robot social skills** such that they might actually survive out there when they’re deployed in real human-populated environments? Our HRI research community has been chipping away at this challenge for many years now, but it’s often relegated to only “social robot” applications. Any robot that will have to work with (or even near) people, will need social skills.

***4. For students entering the HRI field, what would you say are skills (technical and others) that are must-haves and that you and other companies look for when hiring?***

When hiring, we are often looking for what IDEO used to call “T people” – people who have deep expertise in at least one area, but who also have enough of breadth of understanding of other relevant disciplines that they can work well together as part of a multidisciplinary team. Robotics is multidisciplinary field and doing strong HRI research requires even more disciplines. Another must-have is strong communication skills. If a candidate cannot explain their work clearly and concisely (without leaning heavily on jargon), then they probably need more training. Finally, being curious, open-minded, and curious are important for understanding customers, users, and other stakeholders in a robot’s ecosystem, but also for working well with others, who come from different disciplines beyond the usual subdisciplines of robotics (e.g., workplace ethnography, cultural psychology, human factors and ergonomics).

***5. How do you see the role of academia in addressing these current challenges in HRI? Do you think there is room for collaboration between academia and industry in solving these issues?***

Academia is a great place for conducting exploratory studies, learning and developing new research methods, and developing bleeding edge technical capabilities. It is often difficult to make time for that kind of work in industry.

Yes, there is absolutely room for collaboration between academia and industry. We need more collaboration between academia and industry in order to translate scientific insights into real robotic products and services. This will require:

- Much more humility, openness, and respect on both sides. I still hear stereotypes from each side of this divide, which are unfounded, e.g., those who can’t do, teach; those who can’t get tenure, end up in industry. Just spend a few minutes to get to know someone on the other side, and you’ll realize how silly and unproductive those stereotypes are.

- Collaborative frameworks that benefit both sides and foster deeper collaborations than simply exchanging money or prestige (e.g., fellowships, internships, hosting sabbaticals, visiting researcher programs)

This is why I look for opportunities to bring my academic colleagues into projects with my industry colleagues through my Hoku Labs work, e.g., short-term consulting projects, product design reviews. It's always fun to introduce good people from both sides to each other and to set the stage for us to chew on concrete HRI challenges together.

## ***6. Any last words of advice?***

Sure! Two things:

- (1) How about we work on real problems that the world is facing today, not only distant futures? Get out of the research lab. Spend time on figuring out which problems are really worth tackling.
- (2) Beware of confusing prototypes with products. Demo videos are not the same as long-term successful robot deployments.