

# A Brave, Creative, and Happy HRI

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I have co-founded companies (and served as their CTO for a total of 28 years) that have delivered tens of millions of robots for the home, and many thousands of robots both to the military and factories around the world.

The users of the home robots are ordinary people from all walks of life with all levels of education. The operators of the military robots typically are young with a high school education. The people who set up the robots in factories are typically factory technicians with some technical training, but sometimes are line workers with no particular educational qualifications. All expected users of these robots have never had any previous experience with robots, nor have they ever read any form of manual about the robots, and all their knowledge of the robots comes from hands-on interaction with the robots in the field. All are trying to achieve some other purpose with the machine, be it cleaning the floor, making safe an improvised explosive device, or automating a perceptual-physical task in a factory. A good user experience (UX) has been critical to user acceptance of the robot. To that end, the user interface (UI) and UX have been key drivers for product management, requirements specifications, customer engagement, design of the robot and interface, and customer testing. In contrast to the scientific literature on control, kinematics, dynamics, graphics, software methodologies, cryptographic security, product life cycle, and lifetime testing, the human–robot interaction (HRI) literature has had virtually no impact on the teams engaged in the development and production of these robots. The teams voraciously read research papers in all areas of robotics except in HRI.

In preparation for writing this piece, I read a selection of recent HRI papers from different authors and institutions.

First, I noticed a fetish for mathematical notation, often with subscripts and superscripts beyond normal roman and greek letters, for which the notation serves not to clarify but to be there for the sake of being there. Unless notation is used to make things easier to follow and reason about, its

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only possible purpose is to obscure simplicity out of fear that simplicity is somehow not enough. I say embrace simplicity. Simplicity can lead to depth. Second, I noticed that the commonly accepted methods for user testing have nothing to do with real users. There are two approaches that seem to be accepted by the community. In one, some ten or twenty real live people are recruited and brought into a lab and are asked to interact with either a lab demonstration robot or a Wizard of Oz simulation of a robot. In the second, a few hundred workers from mechanical turk are used to fill out questionnaires on something that they can see through a web interface. No robots are even present in this second case.

The questions being explored are typically extremely tiny aspects of what should be much bigger pictures of how ordinary people are going to work with a robot in real life to get a task done that actually matters to them.

These experiments all seem analogous to the following hypothetical world of HCI research in the late 1970s.

A group of people who have never used a computer are recruited for an experiment, using variations of Unix commands to manipulate files from a command line interface. The users have never heard of computer files before and they don't in any sense have the utility of files internalized.

The experiment is to determine whether something the experimenters have called utility versus expressiveness is more highly valued. One set of users is taught commands like "rm," "mkdir," and "cat," etc., while another is taught "delete," "new\_directory," and "type\_out," etc. They are asked to do some housekeeping tasks on a file system. Their speed and accuracy is measured, and they fill in a questionnaire about how hard and how intuitive the task was. The paper itself about these experiments touts "statistically significant results," with lots of p values, etc.

No HCI academics bother to invent windows, icons, a mouse, and so on. Such work is viewed as too informal and unscientific.

In the real world of real robots, the interaction between those robots and people is critical. The people have some task to get done that matters to them. The robot is a means to that end.

In real deployments, the program managers and engineers go out and talk to tens or hundreds of real users. They have no preconceived notion of testing one option for a UI design versus another. Instead, they go and ask the users what was easy for them to do with the robot and what was hard. They ask them for what they found frustrating and what they found easier than expected. The teams make spreadsheets, record what they hear, and count how often various things come up in positive or negative ways. They do not start with a preset list of issues; instead, it grows organically. It is not a scientific exercise. Back home, everyone discusses what was found and tries to rank the issues both in terms of severity and frequency.

Sometimes a change that addresses an issue seems straightforward, and a prototype version can be quickly put together and taken back to the user for confirmation that this addresses the user's disquiet. Then, a robust change to the product can be scheduled into the normal development cycle.

Other times, a wholesale restart is required, as happened over the last four years at my current company. Hundreds of person years of effort were expended before a new underlying representation and organization of tasks could be both invented and exposed in the UI while preserving the fundamental look and feel of the previous UX during "train by demonstration." It took years of internal work before it was ready to be rolled out and tried out again in production environments

with real users, giving them an ability to go deep into a task in a way that the previous UI had obscured.

That is the place in which the windows and mice of today are invented in the field of HRI. It would be great to see academics carrying out that high-risk research rather than being sucked into a world of minimal viable safe units of publication. The latter is unexciting; academics should instead be having fun and taking risks. Unlike all other aspects of robotics, it seems to me that academic HRI researchers have collectively convinced themselves to be timid, and creativity and braveness are no longer valued. When creativity and bravery are no longer valued, mediocrity and irrelevance follow. In reality, academics can afford to be much more creative than those working in industry. Please be brave and creative and inventive and happy.

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