

## Talking with Terry Winograd

### *Convergence, ambient technology, and success in innovation*

Terry Winograd is Professor of Computer Science at Stanford University, where he directs the program on human-computer interaction. His SHRDLU program done at the MIT AI Lab was one of the early explorations in natural language understanding by computers. His book with Fernando Flores, *Understanding Computers and Cognition*, critiques the underlying assumptions of AI and much of computer system design, introducing directions from phenomenology. He was a founder and national president of Computer Professionals for Responsibility, and is currently on sabbatical at Google, Inc.

**UBIQUITY:** What has surprised you most about the turn that information technology has taken in recent years?

**WINOGRAD:** In some sense, the way that the Web unfolded was a surprise. I was using the Internet and FTP and Telnet 20 years before the Web. When I first saw the Web, which was pre-Mosaic, I didn't find it very interesting. The first time I saw Mosaic, I was surprised at how totally different the feeling was. It was immediately obvious that the introduction of graphics with text would make a big difference and that it was a new phenomenon. But I didn't have a feel for the way it would go commercial and spawn all the e-business and other companies, partly because that's not an area that I ever thought about much. I was still thinking of it in terms of academic computing people, which, of course, didn't turn out to be its main audience at all.

**UBIQUITY:** Why did you find its precursor uninteresting?

**WINOGRAD:** Because it didn't have pictures. Transferring text and following links to other pieces of text seemed very academic. Putting images in completely changed the feel. That was at a point where any exchange of pictures was a mess, because you had to have the right applications that knew the right formats. The idea that you would just click and a picture would be on your screen was a huge difference in fluency compared to what was there. I think the key thing was having graphics and layout, all the stuff HTML brought.

**UBIQUITY:** I'll interject two things: One is the Web, which was amazing, and another is a search engine like Google.

**WINOGRAD:** What surprised me, which Google was part of, is that superficial search techniques over large bodies of stuff could get you what you wanted. I grew up in the AI tradition, where you have a complete conceptual model, and the information retrieval tradition, where you have complex vectors of key terms and Boolean queries. The idea that you can index billions of pages and look for a word and get what you want is quite a trick. To put it in more abstract terms, it's the power of using simple techniques over very large numbers versus doing carefully constructed systematic analysis.

**UBIQUITY:** You were an undergraduate mathematics major at a liberal arts college. Did you start out as a mathematician?

**WINOGRAD:** I was never a mathematician, really. When I got to graduate school at MIT, I realized that most sophomores probably knew more math than I did as a beginning graduate student. I was formally in the applied math department because my advisor, Seymour Papert, was in the applied math department. In fact, I was doing what would now be called computer science. But of course it wasn't in those days.

**UBIQUITY:** Have you ever thought of yourself as a linguist?

**WINOGRAD:** Linguist is an interesting term. Certainly I was interested in linguistics. When I came to

Stanford I was appointed as faculty in the linguistic department as well as the computer science department. I always was interested in the question of how language worked. So, in that sense, I was a linguist. I was never a linguist in the professional sense of getting deeply engaged in the intricacies of language. The AI approach was to take fairly first-order superficial observations about language and then try to understand how you could implement them. But I was never interested in subtleties about pronoun movement in Swahili.

**UBIQUITY:** What's your current interest? What will you be doing at Google?

**WINOGRAD:** I can't tell you a lot about what I'll be doing at Google. First of all, I don't know yet. Second, their research projects aren't public, of course. The way it happened is that I was interested in looking for a sabbatical. I hadn't taken a quarter off of teaching for 10 years and I needed a chance to think and reflect, to do what sabbaticals are intended for. For family reasons, I couldn't travel out of the Bay area. It didn't seem that interesting to commute to Berkeley, which is the only other place in the Bay area that does HCI research. I was talking to Larry Page, one of the founders of Google who used to be my student, and I said, "There's a lot of stuff you guys are doing that has general applicability to human-computer interaction. It's not just about search engines. It's about how you interact with systems. Why don't we get together?" I suggested to Larry that he and I write a book together.

**UBIQUITY:** And what was his answer?

**WINOGRAD:** He said that it would be great to have me around, but he certainly didn't have time to write a book because he was busy running a company. It was left fairly open-ended as to exactly how it would be structured. For me, the first goal is to immerse myself in what they're doing and understand it and see what is interesting. The second goal is to look at it from the perspective of what it can tell us about how people interact with systems in general and how might that be applied outside of search engines.

**UBIQUITY:** You had a long stretch with Xerox PARC and a long stretch with Action Technologies? Compare the experiences.

**WINOGRAD:** When I started at Stanford, I was a consultant at PARC with their natural language group, which was led by Danny Bobrow, who had been my immediate predecessor in the AI lab at MIT. That group suffered the fate of most natural language groups, which is that you got a few good demonstrations, but nothing that was very practical. He eventually moved on to do other things at Xerox. Over the years I became less involved, especially once I started working with Action Technologies. Action Technologies is the company that Fernando Flores started in order to take ideas from theoretical studies of language and make a practical product. The company still exists and is what you might think of as a "middling success," not the big takeoff that venture capitalists look for, but a solid ongoing business. I was there last week, as a matter of fact, for the first time in a while. I never was there on a regular basis. I was always a founder, consultant, guru-type. I've been in contact in various ways over the years.

**UBIQUITY:** Does it have any products?

**WINOGRAD:** They have two products, which are based on the original ideas, but have evolved over the years. It's not a shrink-wrap software company, which is why it didn't take off like a shrink-wrap thing. It's a one-company-at-a-time, consulting and installation kind of place. It does a lot of system integration. It's still active and doing interesting stuff.

**UBIQUITY:** And the third company you were involved with was Interval. Talk about that experience.

**WINOGRAD:** When Dave Liddle was setting up the company he was very interested in having strong

connections to Stanford and so he got me involved. I spent a year full time there when they started up, recruiting people and starting projects. I stayed on as a consultant for a few years after that.

**UBIQUITY:** You already commented on Action Technologies having, as you phrased it, middling success. Interval and PARC both were interesting cases of inability to commercialize. Would you say that?

**WINOGRAD:** Yes, I would. I can't add anything to what the business pundits have said over the years, because how things turn into business were never questions that I really focused on. The situations were very different. Obviously Interval started out with much more hindsight because of what had happened at places like PARC. At Interval there was more of an explicit strategy to bring things to market as opposed to PARC, where that wasn't the orientation for many of the people there. The problem is that people who are researchers don't care about that at some level.

**UBIQUITY:** Why was Interval unable to succeed in the market?

**WINOGRAD:** Interval got completely sideswiped by the Web. It was started just before the Web. In fact, my first exposure to Mosaic was through a summer intern at Interval. All of a sudden all of the money and talent and everything else got sucked into the Web. It dried up the pool there, to some extent. It's hard to know what would have happened if the timing hadn't been that way. Interval was looking at devices, at things people use, and at the home, and not looking at putting commerce onto the Internet. What Interval wanted to do was noble but overly ambitious, which is to say if you create the right environment you will get creative people to come up with something as radical as what PARC came up with.

**UBIQUITY:** Are you suggesting that having "the right environment" is necessary (or at least desirable), but certainly not sufficient?

**WINOGRAD:** That's right; you can't predict where lightning will strike. Great innovations happen from time to time in history, but they're not something you can just will into being. In a sense Interval was like a very good and well-conceived archaeological expedition. It just turned out that the rocks that Interval happened to look under didn't have something that big under them. There was no "next big thing," like the personal computer. I'm now seeing in the market a lot of the small things that people at Interval came up with. If it had been a little company with a small niche those things would have come out of Interval. But Paul Allen wasn't interested in those kinds of things. He wanted the big things. The process wasn't set up to spin off lots of little things.

**UBIQUITY:** As someone who's been deeply involved both on the academic side and the corporate side, how do you compare them in terms of innovation, style of innovation and success in innovation?

**WINOGRAD:** It changes with the climate and it's interesting to see. There was a period when it was common wisdom that the innovation in industry was very product-orientated, not long-term. But then there have been things like the personal computer, where industry moved ahead with the big ideas. There have been times when in academia you could get funding for something that was interesting theoretically, but had no obvious practical immediate consequences. I think that has shifted. The government-funding pattern over the years has shifted what you're supposed to do in academia more towards what industry is doing. But academia is not good at going all the way in that direction. It's not an environment for getting products out on schedule and coming up with practicality. So, it's a funny mixture. The strength of the academic environment is that you don't have to think about whether an innovation will be practical soon enough to return a profit. The advantage of the industrial environment is that you can throw resources at an idea and

make it happen.

**UBIQUITY:** Tell me about your students. Are they as good as they ever were? Are they better? Are they interested in the same things or different things?

**WINOGRAD:** It's a mix. Certainly, they are as good as they ever were. A place like Stanford has a reputation and an inflow of admissions that is pretty stable in that sense. For many years after I came here students would come into my office saying, "I want to work with computers, but my parents tell me I need to be a pre-med because I'll never make money in computers and they think I could make a good living if I'm a doctor." Then there was a sudden wave of students coming in saying, "This doesn't really interest me that much, but my parents said I should be a computer guy," because, all of a sudden, it was the place where you were going to make your fortune. So, we got this wave of students who were not the people who had spent their childhood learning to program, but who just thought it was a good way to make a living. That's now subsided again. The motivations have shifted. I don't think it's completely back to where it was, but I'd like to know what they're going into now, whether it's investment banking or something.

**UBIQUITY:** Did you have the same experience with grad students?

**WINOGRAD:** This has changed drastically in the past year or two, but a few years ago it was hard to get good students to continue on for advanced study. They could finish their bachelor's degree and then start a company with their friends or make a lot of money in a company somebody else started. The idea of spending more time taking classes or doing a dissertation wasn't very appealing. We're now not only getting a better flow of people who come from undergraduate into graduate studies, but also we're getting plenty of people who are coming back for graduate studies. Our admissions process has folders from former CEOs who are eager to come back and do a graduate degree.

**UBIQUITY:** You just met with some French visitors. Tell us about that.

**WINOGRAD:** EDF, Electricite de France, the electric company, has a huge research arm. They have something like 2,400 researchers. Most of them are doing things like power grids and nuclear research, but they have a group of about 200 or 300 who are doing information technology research. They do studies of how technologies would change work settings. They're set up to do detailed observation and analysis of people using new kinds of computer tools. They don't build the programs or the computer hardware, but they're very interested in the applications.

**UBIQUITY:** You probably have some thoughts about computing around the world. Do you see it evolving at different rates? Do you see it having trouble in certain places?

**WINOGRAD:** Of course, there's the digital divide, as it's called. That is, some countries have a lot of money and can afford to put in infrastructure. Others don't. People in wealthier countries can afford to buy computers. If people can't afford them, development doesn't happen. There's no question that there's this gap. I'm not an economist so I can't say whether that is a naturally growing gap where once you have more you get more, or whether the differences will gradually ease as the price of computers and communications goes low enough. There is a tendency to throw computers at third world problems, which I think is often a distraction. Putting computers in the schools is great, but it may be more important to put teachers in the schools. I think there's always a danger that, because it's advantageous to the computer companies to sell more equipment to have more markets, technological solutions tend to drain away resources from choices that may be better from a developmental point of view. Then there are the political problems. What happens when the Internet cuts across countries that have different standards? You can't sell Nazi memorabilia in France and you can't have pornography in Iran. We see some people expressing a sort of utopian way of thinking about the Internet where problems and

national governments will gradually fade away and we'll have an infotopia.

**UBIQUITY:** Do you believe that there will be an Internet utopia?

**WINOGRAD:** I don't think that will happen. Politics trump technology, ultimately, but cultures will shift. I think it is going to cause upheavals. It has already, in various ways, with China. I think the scene is very different if you look beyond just what's going on in this country.

**UBIQUITY:** Will the wireless phenomena play a strong role in that?

**WINOGRAD:** Wireless is a good factor in closing the divide because one of the things that the third world countries in particular are missing is the wired infrastructure. If wireless is cheap and available, they won't need to put in all that copper. I have some students who were contributing to a healthcare application for a project in India that is bringing laptops to villages. When you get computers down very small and wireless, you can put them in places where there aren't even phones or regular electricity. So yes, I think wireless is going to be a big issue. Interestingly enough, one of the French researchers told me that they are seeing data that will eventually lead to the feeling that wireless is a health hazard. The counter wave to all of this is that people are going to start saying, "Wait a minute. What's all this wireless doing to our heads and our bodies?"

**UBIQUITY:** What are your thoughts on convergence?

**WINOGRAD:** I think there will be convergence in a mobile sense, in that people will carry a device that is a telephone and a small computer and have access to the Web on it. I don't know if it will be done by adding a screen to your cell phone or by adding a microphone to your PDA. It will not always make sense to sit and browse the Web on your handheld device. On the other hand, there are probably many things that you would do with your mobile that you would never think of sitting around in front of your workstation and doing. I think there's a big area of new things to be done there.

**UBIQUITY:** What kind of new things?

**WINOGRAD:** Good question. If I knew of some other than the obvious ones that have already been suggested, I probably would start a company. Location-related stuff, maybe. Things that will show you where you are, what's around you, what you can do there, who you can communicate with, and who's also in the region.

**UBIQUITY:** Do you use a PDA?

**WINOGRAD:** I use a PDA, but not a cell phone. That's probably because I'm not a telephone person. I'm a bit of an introvert. I'd much prefer typing a message and then answering it in my own time rather than having somebody hanging on the wire and talking to me.

**UBIQUITY:** The other day I mentioned to somebody that I couldn't imagine reading "War and Peace" on a PDA and the fellow said, "Oh, you'd be surprised with the new PDAs." Would you be surprised?

**WINOGRAD:** I'd be surprised. The paper media have evolved over the years to suit the way that people work at a desk, sit in a chair, lie back in a deck chair on a ship, or whatever. It's not clear that anything with the weight and thickness of a PDA is the right thing. People have tried doing e-books, which are closer to being like a book in form. They have a long way to go in terms of convenience. In the end, if somebody had something that was nice and light and tablet-shaped and fit my hand well and I could lean back in my deck chair and read it, it might be better than holding the five-pound volume of War and Peace in my hands while I read. But there are a lot of engineering details to resolve before we get there.

**UBIQUITY:** Let's end with a general question about the future. Looking 10 years out, what would you expect in terms of the progression by that time of ubiquitous computing?

**WINOGRAD:** Ten years from now there will be a lot more ambient computing. One of the things we're working on is a room that has wall-sized displays. If you walk into a workplace that's reasonably well funded or maybe in your home, you will see a large wall-like surface with interactive computing available on it. I also think people will carry devices with them that have various powers. They'll use a mixture of modalities. As the processor power needed to do decent voice processing gets small enough and low power enough, we'll see more use of voice interaction integrated with voice transmission. So, you'll have a cell phone on which you can talk to your friends, but you can also talk to the phone and tell it what to do. There will be much more integration among devices - the cell phone, the digital, the wall, and the workstation -- just as the development of modern operating systems pulled different applications together into an integrated environment where you can cut and paste between them. When you walk into a room, you will assume that what you've got on your PDA can be part of what's on the wall. I think all those things are going to happen. I don't know how far they will get in 10 years. The real limitations are on the cost of the hardware. I think the software is headed the right way.