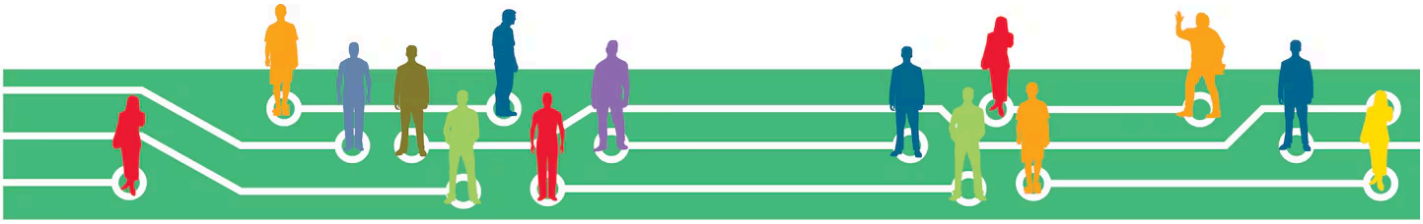
Introducing the human computer

How a circuit made of people could be the building block of a new field

By Samuel Arbesman and Nicholas Christakis June 17, 2012, 12:00 a.m.



- DAN ZEDEK/GLOBE STAFF

In science, progress tends to come in big, sweeping stages. The first stage is observation, as scientists try to categorize and interpret their surroundings. When their observations become detailed and accurate enough, a field typically moves to the next stage, prediction. That's when science starts to become useful: It can actually anticipate how a system will respond to changes, or predict what will happen to it in the future.

Then a field can move to the final stage: control. If you understand a system well, you can use that knowledge to build something new, something that operates according to your wishes.

In physics, our understanding of mechanics and energy has allowed us to build extraordinary things, from the Global Positioning System network to supersonic jets. In chemistry, this control has generated a world of new materials and medicines. The field of biology is making this transition now: Using detailed knowledge of genetics and cellular mechanisms, the young field of "synthetic biology" is actually attempting to build new cells from scratch to do specific jobs. In each of these cases, the natural components of our world are made to act in artificial ways, often for purposes they were not intended.

Could the same thing be done with human beings?

Social sciences—the study of human behavior—are still at an early point in this process. The quantitative study of human behavior is younger than physics or biology. But in the past several decades, its predictive ability has blossomed. Quantitative regularities of social interactions are now known, from how people interact, to how they respond to stimuli, to how they move and migrate about the planet.

But are we at the control stage yet? Do we understand humans well enough that we could actually construct novel, unnatural social systems based on the predictable ways that humans act, the same way we manipulate silicon to make computer chips or cellular machinery to insert jellyfish genes into rats?

A biological example of such total, artificial control was demonstrated by a recent experiment with crabs: A team in Japan used swarms of soldier crabs to make a simple "computer" circuit. They used predictable elements of crab behavior to construct a system in the lab in which crabs gave predictable—well, sometimes predictable—responses to "inputs," and the swarm of crabs was used as a kind of computer, twisting crab behavior for a wholly new purpose.

We wanted to see if this could be done in humans. Like crabs, humans have specific kinds of behavior that can be predicted, in groups. To harness this, we created a survey on Amazon's Mechanical Turk, surveying lots of people at once.

We asked a couple hundred people to complete a string of 1's and 0's, and asked them to make it "as random as possible." As it happens, people are fairly bad at generating random numbers—there is a broad human tendency to suppose that strings must alternate more than they do. And what we found in our Mechanical Turk survey was exactly this: Predictably, people would generate a nonrandom number. For example, faced with 0, 0, there was about a 70 percent chance the next number would be 1.

From this single behavioral quirk, it is theoretically possible to construct a way in which a group of humans can act as what is known as a logic gate in computer science. By running such a question through a survey of enough people, and feeding *those* results to

other people, you can turn them into what computer scientists call a “NOR” gate—a tool to take two pieces of binary input and yield consistent answers. And with just a handful of NOR gates, you can make a binary adder, a very simple computing device that can add two numbers together.

What this means is that, given sufficient numbers of people, and their willingness to answer questions about random bits, we can re-deploy humans for a purpose they were not intended, namely to act as a kind of computer—doing anything from adding two bits to running Microsoft Word (albeit really, really slowly).

We don’t imagine it would be possible to build useful computers using the quirks of human behavior anytime soon—even slow computers from 20 years ago operate with millions of logic gates. It would be wildly impractical, even pointless, to design something similar with people—although it made a good premise for “The Hitchhiker’s Guide to the Galaxy,” where (spoiler alert!) the Earth and its inhabitants are revealed to be a 10-million-year research program designed to discover the Question of Life, the Universe, and Everything.

We see this human circuit as a proof of concept—that what we are calling “synthetic sociology” is possible. The more practical consequences of this idea are more likely to be found in what else we can build using our knowledge of behavior patterns—whether it’s to speed the adoption of useful innovations, or to ease the flow of traffic through cities.

We are still far from understanding people as well as we understand subatomic particles. But we are getting there. And our mathematical understanding of the social sciences is beginning to be powerful enough to truly describe and predict how humans behave—and to try to build from there.

Samuel Arbesman is a senior scholar at the Kauffman Foundation and a fellow at the Institute for Quantitative Social Science at Harvard University. His first book, “The Half-

Life of Facts," comes out this September. Nicholas Christakis is a professor of medicine and sociology at Harvard University.

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