

PROFILE: ZACK BOOTH SIMPSON

An Artist Develops a New Image—With Aid of Bacteria

After dropping out of high school, Zack Booth Simpson became a video game programmer. Now he's at a university working with cutting-edge synthetic biology labs

Nearly 5 years ago, molecular biologist Edward Marcotte recalls, a high school dropout walked into his office at the University of Texas (UT), Austin, to talk shop. Despite the visitor's unconventional background, which included a stint as a video game programmer, Marcotte says that Zack Booth Simpson “won me over instantaneously. He was so clearly intelligent.” They ended up talking for hours on topics such as Marcotte's use of data mining to extract information about the protein networks that control cellular functions.

That was just the beginning. Simpson now has a part-time paid position as a fellow at the university's Center for Systems and Synthetic Biology, where he's shared his expertise and ideas with several labs. His publication record, which includes co-authoring a paper in *Nature* and a chapter in a newly released book on synthetic cells, would make some postdocs envious. “He's jumped right into the top level of research,” says Marcotte, who contributes some of his lab funds to Simpson's salary. “It wouldn't be exaggerating to say Zack changed some research directions in my lab—for example, stimulating my interests in synthetic biology and cell-to-cell variability.” He can “span a variety of disciplines with relative ease, and he brings fresh and interdisciplinary perspectives to each field,” adds Andrew Ellington, another UT Austin molecular biologist who's worked with Simpson for almost as long. Not bad for someone who was once held back by dyslexia and considers science his hobby.

More than 20 years after dropping out of high school during his junior year, Simpson, now 38, says his only regret was “not leaving earlier.” He was bored, and teachers weren't helping him overcome his dyslexia.

Without intending to, he managed on his own to surmount the reading disability by “geeking out” on computer manuals. Meticulously deciphering something he found interesting did what dull reading assignments couldn't, he says. His parents had divorced by the time he decided to quit school, and his mother, a landscape architect, backed his decision. “She thought I'd figure out my own way in the world.”

She was right. After starting out as a “junior programmer” at a database company, by age 23 he'd worked his way up to director of technology at the Austin-based video game maker Origin Systems, which crafted big-

sellors such as *Wing Commander* and *Ultima*. Then, like almost everyone else in the 1990s, Simpson and some friends started their own company. However, the inauspiciously named Titanic Entertainment went under after releasing only one game, *Net-Storm*. It reportedly sold only 13,500 copies, although one Internet forum later tabbed it as “The Best Game of All Time that Nobody Bought.” The lesson from the company's failure, he says, was that “I liked learning things more than I liked doing things.”

It wasn't long before he was doing something else, collaborating with artists, engineers, and computer scientists on a series of interactive exhibits called *Mine Control*. The art installations have appeared everywhere from science museums to department stores, and in such far-flung locations as Norway, Mexico, and Ecuador.

Even children can fool around with *Mine Control* without alarming museum staff because what the children “handle”—light—can't break. Many of the exhibits use detectors Simpson developed to track a viewer's shadow, helping create the illusion of manipulating images that come from computer-controlled projectors. In one of the simplest exhibits, you stand in front of a screen on which multicolored sand appears to tumble from above. Hold out your hand, and the sand piles up in your palm's shadow on the screen. Many of the pieces have scientific themes, letting you tug and bend a Slinky-like RNA molecule, for example. Simpson's favorite, called *Moderation*, meshes the visual style of Japanese anime with an ecological message. How fast you walk around a pool projected onto the floor determines whether the virtual plants and other life that sprout in your footsteps thrive or die out. Walk too fast, and the virtual ecosystem dies out.

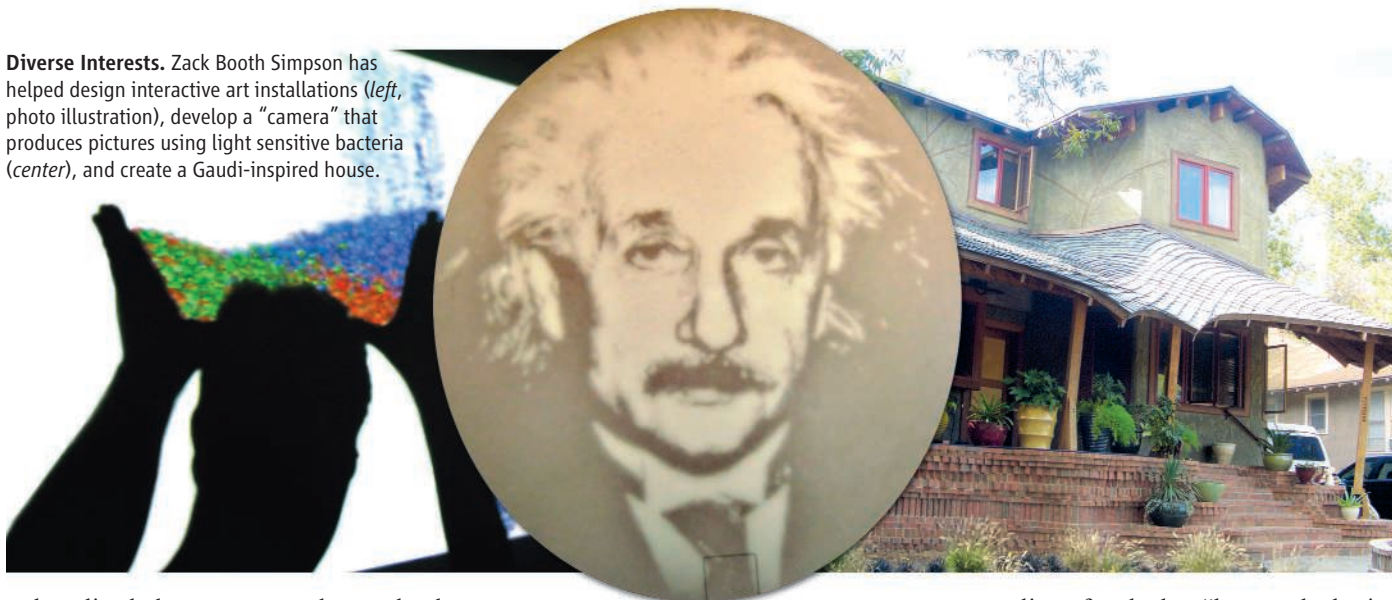
Bacterial snapshots

Although Simpson has lived just a few blocks from the UT campus in Austin for most of his adult life, he didn't try to forge a formal connection with the school until, after one-too-many conversations about the finer points of thermodynamics with his girlfriend, she recommended he find more nerd buddies. That inspired



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Diverse Interests. Zack Booth Simpson has helped design interactive art installations (left, photo illustration), develop a “camera” that produces pictures using light sensitive bacteria (center), and create a Gaudi-inspired house.



a short-lived plan to enter graduate school, which Simpson scuttled after learning that he'd first have to complete a high school equivalency program and an undergrad degree. Instead, he paid a visit to Marcotte.

Simpson arrived in time to help students working with Marcotte, Ellington, and colleagues devise a showstopping demonstration for the 2004 international Genetically Engineered Machine (iGEM) competition, a synthetic biology extravaganza in Cambridge, Massachusetts. The goal of this first-of-its-kind meeting was for teams of undergraduates to construct biological machines capable of performing some interesting task. Because he understood computational problems so well, Simpson's role was to urge everyone in the Austin labs to think big, recalls Ellington: “He was putting forward all these grand ideas for what molecules could do, and we were saying, no, no, maybe, no.”

One of Simpson's big ideas was to use bacteria as an edge detector. Finding the boundary between objects is a standard task in image analysis and something software can achieve. But duplicating the feat biologically wasn't feasible, given the rapidly approaching iGEM deadline. So the team decided to focus on the project's first step: bacterial photography, in which microbes act like the light-capturing pixels on the sensor of a digital camera.

Simpson provided the concept, but the UT Austin team still needed tricked-up bacteria. There, they got lucky, says Marcotte. They learned that chemical engineer Christopher Voigt of the University of California, San Francisco (UCSF), and colleagues had created the perfect biopixel: a genetically modified bacterium that fashions black pigment in the dark but not in the light. A layer of the bacteria can take a picture with pretty good

resolution—they are clearer than some photos from cell phone cameras—though the exposure times required are measured in hours rather than in fractions of a second, as they are for most conventional photographs. The UCSF and UT Austin teams joined forces and showed off their shutterbugs at the competition and in a 2005 *Nature* paper of which Simpson was a co-author.

The biological edge detector was next. Simpson explains that this project required engineering more astute bacteria than what were needed for photography. In an edge detector, a microbe not only has to determine whether it's in the light or dark but also has to know the status of its neighbors. Jeffrey Tabor, who was part of the biofilm team and is now a postdoc at UCSF, and colleagues have now built this device and plan to submit a paper describing it. Bacteria won't be replacing electronics anytime soon, Simpson says. But the two projects provide simple and striking examples of computation with cells rather than microchips. In the future, he says, researchers might build on the similarities between computers and life to create machines with capabilities of living things—repairing themselves if they break, for example, or growing from simpler structures.

Emulating Gaudi

Another scientist to benefit from Simpson's computational smarts is UT Austin biochemist Kenneth Johnson. Simpson helped program enzyme kinetics software now sold by the chemical instrument company Johnson founded. Simpson's contribution, the biochemist says, was applying his background in art and computer gaming to provide the software with intuitive controls and easy-to-understand output. Simpson didn't write

every line of code, but “he was the brains behind what we did,” Johnson says.

Simpson splits his time about 50–50 between his art—which brings in most of his income—and his scientific work. Those dual interests intersect in his fascination with “how processes beget shape.” That fascination shows in the house he recently built in Austin, parts of which reveal the influence of the Spanish architect Antonio Gaudí. Although he wasn't a scientist, Gaudí scrutinized natural forms—not to copy them but to understand “the processes that made those shapes and use that as inspiration,” Simpson says. For example, Gaudí designed pillars that branch like a tree or stand at an angle. A year in Barcelona, Spain, home of many of the architect's famous buildings, fed Simpson's love for that style, and Gaudíesque touches in his Austin home include the undulating eaves over the porch and the staircase, which was inspired by a dead, hollowed-out tree Simpson once saw. It's the kind of house that strangers stop by to photograph, says John Davis, an electrical engineering professor at UT Austin who has collaborated with Simpson scientifically and artistically.

Cynics might dismiss Simpson as a science dilettante. And he admits that he lacks the deep knowledge of someone who's been immersed for years in the biological literature. But Simpson believes that he compensates with a breadth of knowledge, from fields as diverse as economics and ecology, that allows him to see new ways to analyze a problem.

Ellington adds that Simpson's success suggests that there's room for more people in science who follow their own paths. “People who take charge of their education are unique, and that is unfortunate,” he says. “We need more people like Zack who learn for the fun of it.”

—MITCH LESLIE