

The See Change

Huge advances in virtual reality are challenging the nature of experience. Get ready—you may not believe your eyes.



Photo Illustration: Sergey Aleshin

By Sam Scott

IF THERE'S ANY COMFORT in the death drop gaping at my feet, it's in the reminder that I'm just the latest in a long line of people to stifle a whimper in Jeremy Bailenson's lab.

For years, Stanford's Virtual Human Interaction Lab—where Bailenson is founding director—has initiated visitors from around the world into the power of virtual reality, often with the simple task now before me: walking across a rickety plank spanning a 30-foot-deep pit.

Of course, there is no plank, and there is no pit. The scene is a digital mirage delivered by a high-tech stereoscopic headset. But those facts don't seem to mean much to the large, primordial part of my brain that can't quite disbelieve what my eyes are telling it.

Eventually, I heed the quieter voice of reason and shuffle forward—which is more than many in this position manage to do—but my relief at putting the ordeal behind me only reinforces Bailenson's point. Virtual reality—VR, to the initiated—is so realistic, so immersive, that it feels

something like an actual experience.

“We like to say the brain isn't evolved yet to know that a virtual experience is not real,” says Bailenson, a professor in the communication department whose doctorate is in cognitive psychology and who has been studying VR's effects for two decades.

A few years ago such an assertion would have meant little outside a small circle of academics: VR was a futuristic notion rarely seen except in labs and large institutions. But that's all set to change in 2016.

Fueled by the march of Moore's law, advances borrowed from the smartphone industry and vast investment, a bevy of competing high-end consumer headsets will begin landing in living rooms—along with a new universe of content.

And that, to hear Bailenson say it, means a whole lot more than you probably think. “We are going from essentially no VR to potentially pervasive use of the most powerful medium ever,” he says. “What are the consequences of a world where anything can happen at the touch of a button and feel like it's actually happening?”

The speed of the change has surprised even him. Less than two years ago, his lab was running experiments with a now clumsy-looking \$40,000 headset that hung about 5 inches off the face. The day I visit it's using versions of Facebook's comparatively svelte Oculus Rift, soon set to retail for \$600 (robust computer not included).

Certainly, the new technology will lend itself to gaming, the domain driving much of the hype, as well as virtual trips and

learning experiences. But what follows when pornography feels like sex, online gambling feels like Vegas, and social media feels like a party? The answers, Bailenson says, are complicated and contextual.

For someone living in, say, remote rural Alaska in the dead of winter, it might be a useful gateway to a beach in the tropics or a tour of a great art museum; for a typical teen learning adult social skills, potentially troubling downsides emerge. Bailenson suggests that parents get and stay involved. “Do it yourself before you let your kids do it,” he says. “Understand that this is not like watching TV.”

All the fuss about VR can seem overblown, especially if you’ve never experienced “presence,” VR’s signature transporting effect. And there are good reasons to bet against VR’s broader appeal—the tendency for users to become acutely nauseated, for one, especially if there is much movement. Also, the turnoff of wearing a mask, and challenges that no other medium poses, particularly in entertainment. How, for instance, do you tell a narrative story to a viewer who starts gazing the wrong way during the big reveal? Will people truly want the intensity of being inside a story, particularly a violent video game in which the dying seems real?

Howard Rose, a Stanford residential fellow and CEO of Deep Stream VR, acknowledges VR’s vast entertainment potential but suspects that its greatest future role may be closer to tool than to toy. His own company makes an app called Cool!, which is designed to immerse patients in a virtual world so thoroughly that they can manage chronic pain without drugs. Imagine a burn victim taking a virtual walk through a snowy forest.

“I do think the serious uses of VR are going to be a much bigger market than entertainment,” he says. “Health care and education and design and architecture and training for doctors—the uses are much more significant and widespread than just entertainment.”

But as confirmation of VR’s power to enthrall, consider Jaunt VR, makers of cinematic VR cameras, content and editing software. Using a prototype camera, the three founders made a 3-D recording of themselves tossing a NERF ball in their office and showed it to potential investors. The result: nearly \$7 million in Series A funding. “I could only react by gasping and giggling,” wrote one early viewer, a consultant on naming the company. “I could swear that the ball was being tossed around me.”

“It was probably the easiest fund-raising I’ve ever done,” said Jens Christensen, PhD ’91, CEO of Jaunt VR, which has since received more than \$100 million and produced a variety of immersive films that put the viewer everywhere from the stage of a Paul McCartney concert to the face of a mountain.

Such offerings are just scratching the surface, says Jay Borenstein, ’94, MS ’94, a Silicon Valley veteran who teaches VR coding at Stanford. He likens the rise of VR to the transition from radio to television. Much of what followed was essentially televised radio; it took years to realize the reaches of the new form.

As creators master VR’s potential, Borenstein expects the results to be just as far-reaching. “I am a real believer that the medium will be as transformative as television was, as the Internet was,” he says. “It is a profound leap ahead from the two-dimensional ways we experience things today.”

He also echoes a common refrain of VR creators—one borne out in Bailenson’s research—that VR allows the viewer to step into another’s shoes with unprecedented power. Indeed, VR has been embraced by documentary filmmakers who have used the medium to bring viewers inside uncomfortable environments, helping them relate to urban hunger, domestic violence and forced migration.

“It connects humans to other humans in a profound way that I’ve never seen before in any other form of media,” said filmmaker Chris Milk in a 2015 TED talk.

It can also put you in another’s cleats—the idea behind STRIVR Labs, a company that is making waves in professional sports. Bailenson co-founded it last January and carries the title “chief visionary.”

The morning I arrive at STRIVR, *Sports Illustrated* happens to run an online profile of Carson Palmer, the veteran quarterback for the Arizona Cardinals who was in the middle of a career season and not shy about crediting STRIVR’s role in it. “I don’t buy into all the new technology,” he says in the piece. “I am all in on this.”

Once CEO Derek Belch, ’07, MA ’08, hands me a headset, it takes me only a moment to get a sense for why Palmer is so



Photo: Howard Rose

DOESN'T HURT TO TRY: Doctors are using VR as a pain management tool.

enthusiastic. Suddenly I'm gone from STRIVR's cramped headquarters in a small Menlo Park house and in a place I have no right being—behind center at a Stanford football scrimmage.



Photo: Tamer Shabani, '14

SEEING IS BELIEVING: NFL commissioner Roger Goodell checks out the STRIVR trainer.

An instinctive turn over my shoulder reveals a cluster of watching players and coaches. I look down to see green grass, up to clouds, and before me to a cluster of linemen crouching so close we could almost touch. It's a fully fleshed, three-dimensional world sewn together from cameras facing all directions, and I am its center.

Belch, a former Cardinal kicker who developed STRIVR while working as a graduate assistant coach for the football team and earning his master's in Bailenson's lab, tells me to look for a receiver running an out pattern. I am barely qualified to take a snap in two-hand-touch, but I feel a flash of satisfaction at keeping my focus amid all the red-and-white jerseys.

But my success is short-lived. I've been sacked, Belch tells me, restarting the play and pulling my gaze left. Sure enough, a blitzing cornerback is barreling down. "You need to hit your 'hot route,'" he says, football jargon for a short, quick pass to a nearby receiver.

I take the mask off, clearer about the reasons for STRIVR's growing reputation. Why, for example, Stanford head coach David Shaw, '94, put his own money into starting the company. Why seven NFL and 13 college teams in addition to Stanford have signed on since STRIVR started. It's like a flight simulator for athletes.

But in the scheme of what lies ahead in VR, STRIVR is also relatively simple—a highly immersive video that allows you to see a 360-degree virtual environment. More interactive apps will give you entrée into whole new worlds.

AltSpaceVR, for example, is a Redwood City company led by former rocket scientist Eric Romo, MS '03, MBA '06, who grew interested in the social potential of virtual reality after reading *Infinite Reality*, the 2011 book Bailenson co-wrote with Jim Blascovich, a professor at UC-Santa Barbara.

AltSpace enables a networked VR world where you can hang out, chat at a Super Bowl party, play Dungeons & Dragons, or stream Netflix onto a shared screen, all with people from around the world in the same room.

"Spatialized" sound conveys the changing distance between avatars, our virtual bodies. Voices are louder as you get closer, softer as you move away, in one ear or the other based on positions.

The AltSpace world is so complete you can check a web browser to read your real-life emails while in VR—something Romo does if he's spending hours in a headset giving demonstrations. Once, early on, he spent six hours in a headset as others came and went. "I watched an awful lot of YouTube that day."

"I was very weirded out by how normal it felt," says Stanford junior Aashna Mago, co-founder of the student club Rabbit Hole VR, who took time off during her sophomore year to work for a VR accelerator. Her longest continuous span of time in a headset was during her visit to AltSpace's actual offices, a tour carried out almost entirely in VR.

AltSpace gets closer to the social future that Facebook CEO Mark Zuckerberg alluded to in his message announcing the company's \$2 billion purchase of Oculus in 2014: "Imagine sharing not just moments with your friends online, but entire

experiences and adventures,” he wrote.

It also raises some of the interesting questions about how the brain’s difficulty parsing the virtual from the real will play out in social situations, a recurring theme in Bailenson’s research.

In real life, for example, people often feel more favorable toward those who subtly—and often unconsciously—mimic their body language in conversation, the so-called “chameleon effect.” The same holds true in VR, according to research by Bailenson and Nick Yee, MA ’07, PhD ’07.

The wrinkle with VR, though, is that there are no limitations. Our avatars can be designed to do anything, from flying to breathing fire. They can all be broad-shouldered, thin-waisted and beautiful.

And in that world it’s no great feat to make super-mimics, allowing someone to, say, automatically radiate a date’s smile to win him over or improve her teaching by uniquely copying each of the students in a virtual class. But it can also mirror a handshake with a goal of persuading someone to do something he or she might not otherwise.

Likewise, Yee and Bailenson found that making your avatar taller can lead to assuming a strikingly more aggressive posture in negotiations, an effect that can continue even if the parties reconvene outside of VR. In one study, in which student volunteers negotiated on splitting \$100, participants with short avatars were nearly twice as likely to accept a poor offer than were ones with tall avatars.

Bailenson’s lab is also early in studies on the effects of VR on young children, an area with scant research. In a previous study, they subjected elementary school children to a virtual experience where the children saw their own likenesses swimming with whales. A week later, a follow-up found half of them had false memories of themselves actually swimming with whales.

Considering how seriously parents take the question of screen time for media like iPads and television, Bailenson is bracing for a high level of interest as VR hits the market. “I am going to be getting phone calls all the time,” he says.

But if Bailenson is alert to concerns about VR, he’s also keyed into its potential for good. The lab has found that putting people in virtual reality can get them to change their behavior in positive ways. They save more for retirement if they see older versions of themselves, exercise more if they see their avatars lose weight as they work out, and show more empathy if they see the world through another’s eyes, quite literally in the case of a color-blindness simulation.

In one study, researchers found that VR test subjects who had just cut down a virtual tree used far fewer paper towels in real life when cleaning up a spill than did subjects who had only read a description of tree cutting.



Photo: Jemal Countess/Getty Images

No one really knows how long VR affects people over time, Bailenson says. To his knowledge, only two longitudinal studies have ever addressed the question—both done by his lab, with inconclusive results. One of the reasons Bailenson is excited by the advent of more affordable, more mobile headsets is that they will enable studies over time to fill in such blanks.

He’s creating a full VR version of a real Mediterranean reef that is near underwater volcanic vents spewing carbon dioxide. The gas acidifies the water, creating a zone of death that foretells what will happen to the oceans as they suck increased CO₂ levels from atmospheric pollution. “I was blown away by how much it brings you there,” says Fiorenza Michelli, a Stanford professor of biological sciences who is working with Bailenson.

The project allows users to explore the reef and adopt the vantage point of the coral as it tries to survive in an ever-degrading environment where all the fish are replaced by algae by the year 2100. Bailenson hopes to build awareness of a looming but largely ignored environmental disaster.

Bailenson is testing VR effects on empathy. You won’t breathe in the smell of the sea, but that might be only a matter of time. In five years, Bailenson predicts, headsets will be smaller and less obtrusive, content creation will be easier and more robust, and VR will address the full array of senses. His lab is beginning to explore ways to conjure virtual scent.

Of course, even that may not entice you into a headset. But take heart, they may not be needed in 20 years. “As crazy as it sounds today, we’ll probably be using sensors that are embedded in the human body to render these experiences,” Borenstein says. “If I was a betting person, I’d bet that.”