

January 26, 2010

This is the print preview: [Back to normal view »](#)

**Daniel Heimpel**

Freelance journalist

Posted: January 26, 2010 08:51 AM

## Revolutionizing Sleep Science

For a man sitting on a rocket ship, 30-year-old neuroscientist Dr. Philip Low maintains a steady hand. In it, as he sits in his ethereal La Jolla, CA offices of his startup NeuroVigil, Low holds his miniature iBrain device. The size of two pennies, the miniature iBrain marks what scientists, doctors and venture capitalists see as holding the potential to revolutionize the study of sleep, speed the diagnosis of disease and tap into the multibillion dollar sleep and neurodiagnostics markets. "We are about to give people access to their own brain," Low says with cool confidence.

Seventy Million Americans suffer from some type of sleep disorder. The most prevalent is Sleep Apnea, afflicting nearly a quarter of all American men and nine percent of women. For tens of millions of people in this country nights are a series of gasps and broken deep (Rapid Eye Movement, REM) sleep. Obstructive Sleep Apnea, the most common form, is caused by a blocked airway, like oversized tonsils or a throat restricted by obesity. Central Sleep Apnea can be caused when the brain doesn't react to an inordinate spike in Carbon Dioxide, which normally forces breath. Mixed Sleep Apnea is a combination of the two. Many live in a foggy twilight, which can be marked by irritability, male impotence and constant lethargy or much worse. "If they don't fall asleep and crash driving to and from their job, the long term effects on cardiovascular and brain function are factors in reducing lifespan," says Dr. Richard T. Loving of the Scripps Clinic Sleep Center. Just as an example, a recent study out of Emory University linked Apnea to thicker blood and heart disease. In short, not sleeping can be fatal.

The American Academy of Sleep Medicine ([www.aasmnet.org](http://www.aasmnet.org)) warns that 80,000 Americans fall asleep at the wheel every day, 250,000 sleep related auto accidents occur every year and 20 percent of all fatal crashes are caused by drowsy driving.

The most common remedy for Sleep Apnea is the CPAP machine, which pushes a constant stream of air through a mask and into a patient's nose all night long.

The most common method of diagnosis is a sleep test or polysomnogram, administered in austere hospital rooms in which patients' heads, faces, chests and legs are hooked up to a half-dozen electrodes or more. Wires from these stream out to a clunky receptor placed at the side of a bed. And then, the lights are turned out. In this wholly uncomfortable environment, people who battle with sleep in their own beds every night are expected to drift into recordable somnolence.

Currently technicians, in order to obtain a clinical diagnosis, have to manually analyze this mixture of data including the saturation of oxygen in the blood, leg movement, eye movement and most importantly the electric waves emitted by your brain called Electroencephalography, or EEG for short. Depending on the level of complexity, this can take several hours.

Using SPEARS, a high-powered algorithm Low developed while completing his Ph.D. at the Salk Institute in La Jolla, the young brain scientist has repeatedly shown similar results when comparing his sleep test with traditional ones. The breakthrough here is that instead of analyzing multiple streams of data, Low is showing the ability to find similar results while looking at only one EEG reading. The information is shuttled from the single electrode to a transmitter the size of the latest iPod shuffle. Then the EEG reading can be wirelessly transferred from a person's home computer to NeuroVigil for instant analysis -- no technicians. Last October, Low demonstrated such a device, in a live presentation at TEDMED, where Low was famously introduced by Dr. Paul Jacobs, Chairman and CEO of Qualcomm as "the smartest person in the room". There, he beamed conference organizer Marc Hodosh's brainwaves straight to his cell phone.

The iBrain has shown that it can do what a Medusa-head of electrodes and hours of human labor with one electrode and in seconds. While there are "innumerable" home tests on the market, according to Mark Mahowald the Director of the Minnesota Regional Sleep Disorders Center, many of them are unreliable and can only say whether or not a person has Apnea, which often doesn't help people with a wide spectrum of other disorders. "People need sleep physicians before they need sleep studies," Mahowald, who is not familiar with Low's work, says. There are currently 26 home sleep devices on the market ranging from helmets that measure forehead Venous Pressure to something called a LifeShirt, which monitors breathing, according to David Kuhlmann, Medical Director of Sleep Medicine at Bothwell Regional Health Center in Missouri. But Kuhlmann, who recently gave a talk about in-home devices to members of the American Academy of Sleep Medicine, says he is yet to hear of any device that uses a single EEG electrode like the iBrain. "That would be pretty revolutionary," he adds.

Low and other prominent scientists believe this will open the door for many more tests than the seven million already administered every year. The ease by which the results can be computed will mean an ever-growing database of information about sleep and a vehicle into the currently uncharted depths of brain activity. "You will find things you didn't expect," says Rhodes Scholar and UCSF Assistant Professor Michael McCullough, who has watched Low's work closely. "It's like the Hubble telescope. When you look at a part of the universe that you have never looked at before you will find things you never expected."

A known quantity in the field of Neuroscience, not only because of SPEARS and the iBrain but earlier comparative neuroscience research demonstrating the complexity of bird sleep, Low has persistently been courted by Academia: "Before he defended his one-page [Phd] thesis, Philip had been short-listed for prestigious academic appointments by the likes of Harvard, Caltech, Max-Planck and Oxford" wrote Nobel Laureate Roger Guillemin in a letter to the US Government (Guillemin was President of the Salk Institute and a mentor to Low's when he was a student there until 2007). Instead, Low accepted limited faculty positions at Stanford and MIT and launched his award-winning company. Dr. Luca Finelli, another of Low's contemporaries at the Salk Institute and now a leader in Neuroscience at Novartis recalls: "Philip impressed me from the beginning for his exceptional passion for science and a strong innate curiosity that has been driving his progressive fascination for sleep with the most innovative, fast, simple reliable and objective solution ever seen." For his research and entrepreneurial achievements, the US Government granted Low "extraordinary ability" status in March 2008.

The rocket Low wants to ride into the universe of the mind has two stages. The first is a consumer device (the iBrain) that can tap into the multi-billion dollar business of clinical sleep testing. Currently clinical sleep tests average \$3,000 - \$3,500 a night, comprising a current minimum market of \$21 billion, according to Low. But the real money comes in stage two. Once the booster is dropped, Nobel Laureate Roger Guillemin, sees myriad applications for the iBrain: "Pharmaceutical companies want to use this new technique to assess the

effect of pre-market drugs on the brain ...The Defense department and the transportation industry would like to use it to monitor alertness in personnel operating transportation vehicle and nightshift workers. The list goes on as you can imagine."

In an essay called "Ask not what the brain can do for sleep -- Ask what sleep can do for the brain" published last December by *Frontiers in Neuroscience*, Low wrote: "1) Can we leverage the dynamic oscillations produced during sleep in order to systematically detect severe neuropathologies? 2) Can we use sleep to make safer drugs? Yes, we can." One of the fields Low is paying close attention to is Alzheimer's. In fact, Low will be hosting the first International Congress on Alzheimer's Disease and Advanced Neurotechnologies. The conference, which is open to the public, is designed to accelerate technological innovation within the field of Alzheimer's Disease and will be attended by clinicians, researchers, industry and government (The French Government has taken a special interest in the conference and invited Low at the Elysee Palace when he was planning the conference).

Indeed, it isn't only revered academic institutions and governments that come knocking; Big Pharma wants a piece of Low's brain too. The likes of Roche, Johnson and Johnson, Eli Lilly, Pfizer, Merck and Novartis have negotiated contracts with the tiny startup, which became profitable in 2009. Last October, Roche and NeuroVigil announced a commercial partnership to use the iBrain in home based clinical trials and assess the effect of some of Roche's pre-market drugs on the brain.

Another reflection of the promise of the technology was during the Draper Fischer Jurveston (DFJ) Venture Capital Challenge in May of 2008. The competition brought together the best and brightest young entrepreneurs from across the country. Low and NeuroVigil won the grand prize of \$250,000 by a landslide. Three days later, Low won the grand prize in San Diego. "That was a good week", Low recalls. Among the throng of venture capitalists looking to invest in the new companies featured at the DFJ competition was Larry Marshall of Southern Cross Venture Partners ([www.sxvp.com](http://www.sxvp.com)), Australia's largest VC fund. Because of the vast market, Marshall sought out another Venture Capital firm and offered Low a term sheet, which Low rejected. Marshall explains that Low wanted to run the company on his own terms. "That is indicative of a good entrepreneur."

In an interview with the journal *Neurotech Insights*, Low said he had turned down \$19.5 million in VC funding in 2008 (and even more in 2009) because NeuroVigil didn't need all that money at once. "I had to turn down a billionaire the other day," Low says. In addition to DFJ, NeuroVigil has received the backing of some of the world's savviest entrepreneurs and investors, spread across Southern California, Silicon Valley, New York and Basel, Switzerland, including Dr. Irwin Jacobs, co-Founder of Qualcomm and Dr. Howard Morgan, former President of New York based Renaissance Technologies.

With the unknowns of the brain as vast as the cosmos and the applications for his device as numerous as the stars, Dr. Low retains an iron-grip on the throttle of his rocket ship.

Join HuffPost Social News and connect with your friends on Facebook

