HEADLINE

Bringing Research to New Heights

SUBHEADLINE

Doctoral student Kevin Schmidt just scaled the tallest mountain in South America in an attempt to understand what it takes to conduct research at 20,000 feet

BYLINE

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“Sleeping in the clouds can be draining,” says Kevin Schmidt, a cognitive neuroscience doctoral student at Northwestern and applied neuroscience researcher at the Air Force Research Laboratory (AFRL). “There’s far less oxygen at high altitude, and the tent I’ve been sleeping in at night reproduces that environment.”

Sitting at a coffee shop the week before Thanksgiving, Schmidt opens his laptop to a plot of squares and circles. Each is color-coded to represent the quality of a night’s sleep throughout the past three months.

The data reveals a potential trend: the first evening at a new “altitude” typically results in poor sleep, but after a few nights, Schmidt’s body and brain seem to adjust.

The hypoxic, normobaric setup — which alters the oxygen levels but not the barometric pressure exerted on his body — simulated Schmidt’s ascent of Argentina’s Aconcagua, the tallest mountain in South America. Schmidt reached Aconcagua’s 22,837-foot summit just days ago, capturing blood-oxygen levels and heart rate metrics along the way. Resting in Chile, he will review his data and data of fellow climbers Jake Quartuccio of JQ Scientific and Simone Erchov of Research Solutions Consulting, to determine if the acclimatization regimen helped their bodies better respond to the thinner air.

“There have been numerous explorations of acclimating to low-oxygen environments while at or near sea level (Evanston’s elevation is 610 feet), but the longest study was shorter than two weeks,” says Schmidt, who theorizes that it may take far longer for the body to see benefits from the overnight exposure. “We are interested in determining if there are different ways to train the brain and body to react better to low-oxygen environments.”

The research is one of two protocols that took place on the mountain. The other was designed to explore aspects of the brain’s ability to function in low-oxygen environments. Climbing a mountain puts stress on the brain, which sometimes leads to catastrophic mishaps.

“In the lab we can try to study stress under very controlled conditions, yet the level of stress you get on a mountain is something we cannot recreate” says Schmidt, a graduate student in Paul Reber’s lab at Northwestern, “and even better, using mountains as a laboratory could hels us transition discoveries to application.” This project won’t reach the level of precision of systematic data collection within the lab, but provides an opportunity to get some subjective data and bring the scientific ideas out into the field.

“The brain has different cognitive skills that are differentially affected by physiological constraints and stressors,” says Schmidt. “By looking at a number of different cognitive tests, this climb gives us the opportunity to get some rare data that we couldn’t get in the lab about the ways human cognition may break down in low-oxygen environments. We think things like attention and vigilance are probably quite impacted while some forms of memory may be pretty resistant to being impaired.”

Schmidt’s graduate research in the Reber lab will eventually focus on the study of implicit memory — which differs from typical explicit, or thought-based recollection — and shows up in behavior as a hunch or intuition. In their prior research, students working with Reber have helped to developed laboratory tasks to isolate the non-conscious skill learning system in the brain and encode information into it, outside of awareness. An application of this work was recently demonstrated by Reber in a National Science Foundation project that delivered a proof-of-concept authentication system resistant to coercion by storing password information implicitly in the brain and outside the user’s awareness.

Reber, psychology, has been studying the human brain, particularly the cognitive neuroscience of implicit memory and skill learning for more than two decades.

“In life, we regularly use these memory systems in parallel in complex cognitive tasks. Much of our early work was aimed at dissociating these forms of memory but our more recent work has been focused on interactions between them. For example, knowing when to trust our intuitions or how to balance practice-based implicit knowledge with memorized information in skilled performance,” says Reber.

Schmidt is building towards using Reber’s implicit learning technology to test the limits of the non-conscious memory system in extreme environments, like those on a mountain. The hypothesized effect is that using implicit, non-conscious knowledge will be relatively unimpaired by stresses related to low-oxygen environments or mountain climbing exertion.

Schmidt joined Reber’s lab in September to pursue a doctorate in cognitive neuroscience through a Department of Defense Science, Mathematics, and Research for Transformation (SMART) Scholarship. Schmidt is also a member of the United States federal civil service and he previously used a SMART scholarship to complete his master’s degree at George Mason University.

“The collaborative rather than competitive environment among faculty at Northwestern is what attracted me to the University,” says Schmidt. “Being a part of the Reber lab has been amazing and I’m looking forward to the years of research and discovery that lies ahead.”

Schmidt, Quartuccio, and Erchov flew to Santiago on December 8 — the mountain borders Chile and Argentina — obtained official climbing permits, and then spent two days hiking to basecamp, some 14,000 feet above sea level.

While at basecamp, each climber took a specially designed exam on a tablet to test their brain’s baseline cognitive performance. The team was also tested at higher camps on their way to the summit to understand cognitive dynamics in these increasingly extreme conditions.

The climbers are utilizing Air Force technologies while also piloting new ways of training the body and brain that might lead to better performance at high altitude.

“The goal is to gather enough data to apply for funding and launch a formal study testing the different memory systems of the brain in low–oxygen environments,” says Schmidt. “Though this was not systematic data collection, some of what I will learn is what is required to conduct an experiment on a mountain where temperatures could be -30 degrees Celsius.”

Schmidt became an avid rock climber while an undergraduate at Wright State in Dayton, Ohio, and began his foray into high-altitude mountaineering with an ascent of Mt. Kilimanjaro, the tallest peak in Africa at 19,341 feet, a year and a half ago. Schmidt and his fellow climbers will discuss their Aconcagua experience at the US Embassy in Santiago next week. When Schmidt returns to the US, he will spend January 1 through 7 in Washington’s Cascade Mountains, where he will embed with a climbing unit and conduct more research tests while becoming skilled in glacier ascents.

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In 2015, Northwestern’s International Institute for Nanotechnology was awarded a U.S. Air Force Center of Excellence grant to design advanced bioprogrammable nanomaterials for solutions to challenging problems in the areas of energy, the environment, security and defense, as well as for developing ways to monitor and mitigate human stress. The five-year, $9.8 million grant established the Center of Excellence for Advanced Bioprogrammable Nanomaterials, the only one of its kind in the country.