

the hidden system

Human behavior has as much effect on the body as disorders of circulation or respiration, but is far less understood. The Vermont Center on Behavior & Health seeks answers that can change patients' lives.

by Joshua Brown

On a hazy June afternoon, Carrie Dyer sits at a picnic table near the playground in Battery Park in Burlington. With one arm she's holding her three-month-old baby, and with the other she's sipping water from a bottle. I'm chowing down on French fries from Beansie's Bus. I skipped my lunch to go running and now the salty, fatty fries taste great. Dyer turns to encourage her seven-year-old daughter who is working her way across the monkey bars. Then she takes another sip of water, brings her baby into a close embrace, and continues talking.

"I started smoking when I was eight years old," she says. "I was at my dad's girlfriend's house and she had older daughters and they were trying to push me into smoking. And I didn't want to. And I went into the house and told my dad and I was told, 'do whatever they want. You're getting in my way.' So that's how that one happened. And the smoking just stuck."



Carrie Dyer and her daughter at Burlington's Battery Park playground. Dyer's participation in a Vermont Center on Behavior and Health study is helping her break a smoking habit begun in early childhood.

Now Dyer is trying to get unstuck. “When I used to work traffic control I was up to four packs a day,” she says. But on January 5, 2014, well into her second trimester of pregnancy, at age 38, she quit. Her baby — her fourth child — was born in March.

“Well, I’ve pretty much quit,” she says with an unguarded smile. “I’ve slipped up a few times here and there, but I’ve passed all my UAs since I started.”

The “UAs” are urinalysis tests for nicotine. And what she started was participating in a clinical research study at the College of Medicine’s new Vermont Center on Behavior and Health, directed by vice-chair of psychiatry and Virginia H. Donaldson M.D.’51 Professor Stephen T. Higgins, Ph.D.

“You can think of behavior as a biological system, like respiration or circulation,” Higgins says. “How well could you practice medicine if you ignored circulation? In medicine in the past, and to some extent today, we have left out one whole system — behavior — which needs to be studied as a key part of keeping people well, to understand the source of illnesses, and where you need to intervene.”

Higgins is particularly interested in one kind of behavioral intervention: incentives. For her healthy behavior — not smoking — Carrie Dyer gets paid. A clean urine test means cash or vouchers for merchandise. “I have anxiety and depression and PTSD — I have traumatic brain injury as well. In ’02 I went through the windshield,” Dyer says, brushing her short greying hair with her fingers. She’s been unemployed for three years, has heart problems, qualifies for Medicaid, and is applying for disability. She has two older children who don’t live with her.

“Not smoking makes my stress get outrageous,” she says, but she has pressing reasons to quit. She looks at her baby and then across the woodchips to where her other daughter is climbing backward up a slide. “It’s scary for me right now; she’s seven. She knows I’m a smoker.”

While the Vermont Center on Behavior and Health is new — with \$34.7 million in funding awarded in September



Director of the Vermont Center on Behavior and Health and Vice-Chair of Psychiatry, Virginia H. Donaldson M.D.’51 Professor Stephen T. Higgins, Ph.D., is seen here at the center’s 2014 research conference in Burlington. Barely a year old, the center has already hosted two such conferences, attracting participants from across the globe.

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2013 from the FDA and the NIH — Higgins’ work on how to improve health through behavior change is not. Three decades ago, the crack cocaine epidemic was raging in many U.S. cities. In the late 1980s and early 1990s, Higgins led studies on cocaine abuse and dependence that are now landmarks in the field of addiction treatment. Many other experimental treatments, including a raft of different medications and group therapies, were, “failing miserably,” Higgins says, “but our trials showed that financial incentives work.”

To this day, there are no FDA-approved medications to treat cocaine addiction, but Higgins and colleagues’ success with retail vouchers as a fundamental part of treatment for cocaine addicts led them to explore how this approach could work with other types of addiction. The new Center on Behavior and

Health will expand on several decades of research by a large team of UVM scientists that includes fundamental discoveries on the treatment of opiate and tobacco addictions — and how to help especially vulnerable or difficult-to-treat groups like pregnant women, low-income people, and those with co-occurring mental illness.

“My medication just doesn’t cut it a lot of the time,” says Dyer. “I’d like to have a cigarette just to get away from everything.” She takes a deep breath. “But I’d love to just be done, done, done with smoking. The incentives are just that extra help I need to get over that hump. I get \$50 every time they do an ultrasound of the baby. I get \$50 every time they need me to fill out extra paperwork. Cash. And when I do the breathalyzer and the urinalysis, I get \$90 in gift cards. That’s incredibly helpful, actually. That’s loaded us for diapers for a while!” Other times,

she’s used the vouchers for shoes — she’s wearing the only pair she owns — or for gas cards so her partner, the father of two of her children, can get to work.

Of course, an anecdote is not a significant data set. But Carrie Dyer’s story fits the larger data-rich patterns of behavior that Higgins and his colleagues have been observing for years — with thousands of patients. They’re patterns with deep roots in human evolution. “At the core of addiction is a principle called reinforcement,” Higgins says. “It’s a biological/behavioral system that evolved to mark outcomes important to your survival.” Roughly speaking, if a behavior leads to a reward, we remember that behavior and repeat it — a concept made famous by B.F. Skinner, the pioneering behaviorist who wrote: “the consequences of behavior determine the probability that the behavior will occur again.” As part of this system, our brains are wired to make sure we take pleasure in those activities essential to survival — eating and sex should come to mind. Whenever this brain reward circuit lights up with the neurotransmitter dopamine, we remember: an important thing is happening — and we learn to do this thing over and over again.

There is overwhelming scientific evidence that while reinforcement evolved to aid survival, it now plays a key role in many behaviors that threaten people’s health. “The substances that people abuse and the fatty and salty foods that are so often over-consumed,” Higgins and three colleagues wrote in a 2012 paper in the journal *Preventive Medicine*, “share a common effect of directly stimulating the dopamine-based mesolimbic brain reward centers, which directly increases the likelihood that these same activities will be repeated in the future.”

Which brings us back to cigarettes, French fries, and gas cards. Incentive programs like the ones Higgins and his colleagues have been testing “leverage the same reinforcement process that drives unhealthy risk behaviors to promote healthy behaviors,” he writes. Indeed, financial incentives activate those very same dopamine-based brain

reward systems, the paper notes, that drive repeated drug use, fatty food consumption, and other learned unhealthy behaviors — like smoking. A 2008 study led by Higgins’ colleague, UVM Associate Professor of Psychiatry Sarah Heil Ph.D., showed a 41 percent success rate for paying cigarette-smoking women with merchandise vouchers to not smoke during their pregnancy — substantially better than the 10 percent quit rate achieved by a control group.

Small Achievements Bring Long-Term Success

In a brick office building in South Burlington, at the Cardiac Rehabilitation Center, a young man in dreadlocks and camo shorts sweats on an elliptical trainer, a grey-haired woman in pink velour lifts weights, and a rockabilly tune fills the air. Matt Bessette finishes his fifty-minute workout on a treadmill — and steps into an office to collect \$34. The 62-year-old retired plumber has completed 17 exercise sessions since he started his treatment here following a heart attack. “A year ago, I was driving and I had this wicked pain across here,” he says, drawing his hand across his shoulder and broad chest. “I had pain all over. I couldn’t even use my cell phone. I thought I was going to die right there.” But he didn’t. Instead, several months later, he had two stents put into his heart — and

joined a clinical trial led by cardiologist Philip Ades, M.D., and UVM psychologist Diann Gaalema, Ph.D.

Most people who survive a heart attack could benefit from rehabilitation. A program of education and exercise increases quality of life and decreases chances of dying from heart disease — but less than 35 percent of eligible patients participate in rehab programs. And a vanishingly small number of cardiac patients from marginalized parts of society — low-income or homeless or with substance abuse histories — even start. “We are trying to motivate behavior change in these vulnerable populations,” Gaalema says. All the patients in her new study — including Matt Bessette (not his real name; he was happy to share his story, but asked me to use a pseudonym) — qualify for Medicaid, which means they don’t have much money.

“The incentive schedules we use are based on the idea that changing behavior long-term is hard,” says Gaalema. “The reality is that if you’ve had a heart attack you are going to have to change the way you live and that change will need to be life long.” She points out that even the four months of a cardiac rehab program can be a long and difficult time for patients to maintain their new behavior. “The idea behind incentives is that they break down these difficult behaviors into small,



Professor of Medicine Philip Ades, M.D., right, and Assistant Professor of Psychiatry Diann Gaalema, Ph.D., study the use of incentives to motivate positive behavioral change in patients participating in a cardiac rehabilitation program.

achievable chunks. Putting the focus on what they can do and achieve *today* helps people take these intermediary steps toward the longer goals they'll need to meet. It really is a form of treatment and much more subtle than just paying people to do healthy things," Galeema says.

Besette was randomly assigned to a group that receives a cash payment each time they come to the rehab center and complete their prescribed exercises. "It starts at four bucks for the first one and goes up from there," Gaalema explains. If the patients don't miss a session, the rate builds to \$50 per session. But if they have an unexcused absence, the payment schedule resets to the bottom. After 36 rehab sessions — the maximum covered by Medicaid insurance — successful participants will have earned about \$1,200, "which is not trivial," Ades says.

But it's pocket change compared to the cost of another heart attack. "Preventing one cardiac rehospitalization

is saving \$10,000 to \$30,000," Ades says, "and cardiac rehab is known to decrease cardiac rehospitalization by 30 percent in the first year."

The United States healthcare system is by far the most expensive in the world, but in a June 2014 report from the Commonwealth Fund examining eleven nations — Australia, Canada, France, Germany, the Netherlands, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States — the U.S. ranks last in health outcomes and healthy lives.

In all these industrialized nations, including the U.S., the population's main health problems come from chronic conditions like addiction, coronary heart disease, type-2 diabetes, and obesity. "We can't afford to keep spending more and more to treat disease outcomes that are connected to unhealthy lifestyles," Higgins says. Which is why he and the other scientists in the new UVM center look to

where these lifestyle diseases emerge, that most quotidian foundation: how we behave. Some 40 percent of premature deaths in the US arise from unhealthy personal behaviors, with smoking and lack of exercise at the top of the list. "Many researchers and the NIH are increasingly realizing that we can't just medicate or technologize our way out of these chronic health conditions," Higgins says. "Without recognizing the importance of behavior, we're losing the battle of trying to effectively curb or manage these kinds of diseases."

Heart disease is no exception. "If you look at the research, about 90 percent of coronary heart disease is determined by people's risk factors, most of which is determined by their behaviors," Ades says. "Even if you have a family tendency for high blood pressure and high cholesterol, if you eat poorly and don't exercise and gain weight, you will realize that family history. So even the things that you think are genetic have large behavioral overtones."

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— Diann Gaalema, Ph.D., UVM Professor of Psychiatry

The principle of reinforcement and the tools of behavioral economics, like financial incentives, help difficult-to-treat populations like cocaine addicts and pregnant smokers. Now the scientists at the Vermont Center on Behavior and Health want to understand how well that approach can be extended to much broader health problems, like heart disease — and especially with those people of low socioeconomic status who bear a disproportionate burden of many chronic diseases.

The new study looks promising. "We're seeing more minorities and many other people we've never seen in rehab before," Ades says, "unemployed people, drug addicts, homeless." Often invisible to the medical system — until they hit the emergency room with very expensive problems — they tend

to be "higher risk than the other cardiac patients we see: they have worse cardiac behaviors, exercise less, smoke more, tend to be more overweight," Ades says. "They are the people we need to reach."

"We're seeing them because of the incentives," he says. "They literally get paid to come to exercise." Matt Besette is happy to get the money. "Sure, it's great," he says. "But it's not that important," — now that he's in a groove and feeling better. "I'm getting paid in other ways: I feel great. I have more energy when I exercise on Tuesdays and Thursdays than I do the other days."

In Steve Higgins' seminal cocaine studies, the economic incentives were designed to be a transition, "the bridge, so to speak, to naturalistic sources of reinforcement," he says. "With a therapy called community reinforcement, we tried to enhance areas that in people's lives were generally most meaningful — location, family, recreation — and we used the economic incentives to jumpstart them toward change."

Matt Besette had been fading fast. "One of my few pleasures in life was deer hunting," he says, wiping his sweaty brow, but he could barely get himself to his hunting camp and he was getting winded walking behind his snowblower. "I was just running out of gas. I didn't have the desire to do almost anything." Following the cardiac stents, he began to feel better, "but I was in very bad shape," he recalls. That's where the rehab program helped. "For me, I need structure. I have a treadmill at home, but I don't use it," he says. Once his 36 sessions in the study are over and the incentives stop, he plans to continue coming to the rehab center, join cardiac rehab "phase 3" and continue his workouts. "When I come here, I have to do it. And the other people are real nice." Feeling better, he's happy to help his wife around the house, "hanging pictures and that kind of thing," he says. "Now I'm good for half a day. But that's better than a quarter of a day or nothing."

Vermont Center on Behavior & Health The University of Vermont

The VCBH Scope

The Vermont Center on Behavior and Health (VCBH) was established in 2013, sponsored in part by a Centers of Biomedical Research Excellence (COBRE) Award from the National Institute on General Medical Sciences and a Centers of Tobacco Regulatory Science (TCORS) Award from the National Institute on Drug Abuse.

The VCBH resides within the College of Medicine at UVM, with the director and administrative offices located within the Department of Psychiatry, and participating investigators, collaborators, and advisors residing across 15 academic departments in the College of Medicine and seven colleges within UVM and five other universities. The VCBH is further strengthened by interdisciplinary collaborations with key community healthcare leaders and distinguished scientific advisory panels.

VCBH researchers investigate relationships between personal behaviors and risk for chronic disease and premature death, with a specific focus on understanding mechanisms underpinning risk, and developing effective interventions and policies to promote healthy behavior. A common thread across VCBH research projects is the application of knowledge from the disciplines of behavioral economics and behavioral pharmacology to increase understanding of vulnerability to unhealthy behavior, and the use of incentives and other behavioral and pharmacological interventions to support healthy behavior change interventions and policies. The contribution of socioeconomic factors to vulnerability and the need for interventions and policies to promote health and reduce disparities in disadvantaged populations is an overarching VCBH focus.

Currently, the VCBH is the only NIH-funded center that is applying the disciplines of behavioral economics and behavioral pharmacology to tackling these enormous, interrelated U.S. public health challenges.



VCBH researchers and Associate Professors of Psychiatry Sarah Heil, Ph.D. (top), and Stacey Sigmon, Ph.D. (bottom).

Foraging for Meaning

As the director of the new Vermont Center on Behavior and Health, Higgins has a lot of responsibilities, but he cheerfully agrees to meet me on campus to go for a run. I'm waiting outside the Gutterson ice rink, and he calls on his cell phone to say he's going to be a bit late: he's stopped to pick up a hitchhiker who needs a ride. A few minutes later he pulls up in his car and soon we're running, while he tells me about his own hitchhiking adventures as a twenty-year-old. "I would always pick people up as payback," he says, "After 10 or 15 years of this, I decided I'd done enough, but, today, this guy seemed like he was really in need."

Higgins grew up in a tough working-class neighborhood in Philadelphia. He's the first in his family to have gone to college. He saw heroin epidemics sweep through his community, killing people he knew. He saw the Vietnam vets coming home hooked on painkillers. It's tempting for a journalist to spin a tidy story of origin about how Higgins chose a career studying behavioral psychology with an aim to treat addictions and other health problems in poor communities — helping people in need.

But he doesn't exactly see it that way. "We have all kinds of stories about why we do what we do and who knows how accurate they are," he says. "I grew up around a lot of drug abuse. I know what that looks like," he says. "But I'm not sure that the issues that I'm interested in now, in terms of health disparities and the influence of socioeconomic status, are driven by that history."

"I think that we use language in a way that makes us think we're in charge of things that are really being driven by forces that are external to us," he says. He understands the trajectory of individual human lives not so much as freely chosen narratives, but as patterns of behavior, driven by our deep evolutionary past. "We are foraging most of the time! I think we are trying to do the best we can as signals come in saying: go here; go there. And our evolution has made us exquisitely sensitive to certain signals, looking for food, mates, avoiding danger."

It's a beautiful day and we amble through a stand of hemlocks and across the bike-path bridge in Farrell Park, chatting and enjoying the sunshine. "Running feels great," Higgins says. "It's calming. If it wasn't for running, I'd probably be on some serious psychiatric meds from work-related stress," he says, laughing. He's 60 now and has been running steadily since his hitchhiking days. It's a lifelong pattern of healthy behavior. But, as anyone who has started an exercise program knows, it's not always easy, takes discipline to keep going, and the rewards are delayed. "Cocaine works immediately," he says, "whereas the joy of, say, running a big city marathon is some months down the road and it starts off being rather unpleasant." Higgins would like to find ways for more people to get to those kinds of delayed — but more durable — joys. Or at least that's one story of why he has dedicated himself to exploring a deeper scientific understanding of the incentives and interventions that can shape human behavior. **VM**