

Climate Nudges: Psychological Tools to Fix a Warming Planet

by

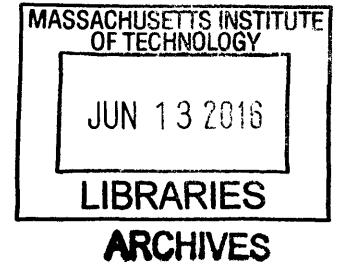
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B.A. Biological Sciences
Dartmouth College, 2009

SUBMITTED TO THE PROGRAM IN COMPARATIVE MEDIA STUDIES/WRITING
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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ABSTRACT

What if, during your next luxuriously long shower, a small device on the showerhead catches your eye? It counts gallons like a stopwatch. As the numbers grow, a cartoon polar bear despairingly watches the iceberg beneath him slowly melt. Small psychological nudges like this have profoundly shaped people's choices in countless fields, from medicine to economics to policy. But can these tiny nudges help us take on the largest problems? Before the Goliath climate change, here stand the pioneers in psychology, economics and energy management, with a behavioral slingshot in hand.

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Climate Nudges: Psychological Tools to Fix a Warming Planet

“Hi,” the man greeted Kate Crosby as she entered his office one day in March 2007. “I’m J.D. Head. And you’re not penetrating my flat roofs.”

Crosby is a mother of two and a former park ranger with an eye for community organizing, who lives in Acton, Massachusetts. Head is the facilities director for the Acton Public Schools. A year earlier, his words would have meant nothing to Crosby. But she had taken interest in roofs, particularly those of the schools, ever since her 16-year-old son had hosted a film viewing in her Acton neighborhood.

Crosby recounted this moment of awakening to me on an evening in 2015 as we exited her front door and descended the wooden stairs of a porch enveloped in gnarled honeysuckle vines. A brilliant sunset of oranges and pinks was fast darkening to blue-grey, and she was afraid she’d left the henhouse open.

On our way to the coop, we passed the spacious dining hall where her son had shown the film, a building she affectionately calls “the Common House.” Through the expansive windows, I could see several families gathered around dining tables. The night of the viewing, Crosby explained, some neighbors and friends had pushed the tables aside, rearranged the chairs in rows, and erected a screen, as was often done for parties or election returns. Then, the movie rolled: Al Gore’s *An Inconvenient Truth*.

The Common House, the henhouse, and even Crosby’s own home (half of a two-family duplex) are all co-owned. To minimize the environmental impact of suburban sprawl, Crosby shares anything, from mowing equipment, to garden space, to a brand new electric Nissan Leaf, with her neighbors. I grew up in the same neighborhood (Crosby and I have known each other for years), and this did not strike me as unusual. Nor was it surprising to arrive at the small, wooden coop only to find that a neighbor had already secured the sleeping hens safely inside the roost.

Crosby’s shock over the Gore film was also a communal experience. “My neighbors and I were lucky to have the opportunity to process it together or it would have been paralyzing. Just the scope of energy issues ...” she said, her voice trailing off into silence as we made our way back to her house.

Crosby was no stranger to environmental issues. But even as a park ranger, she’d never encountered anything as immense as climate change. She recalled how Gore needed to ride a mechanical lift several yards up the y-axis of a projected graph just to indicate the abnormally high the levels of greenhouse gases in the atmosphere. “The graph just kept going up and up and up,” she said.

Months after the screening, when she saw a sign to “Win a Free Solar Panel for Your Town,” Crosby and her son set out on a campaign to get one for Acton. It turned out “free” was a little misleading. The company that offered the panel told her at least 150 local households needed to make a small donation to a renewable energy nonprofit in order for the town to qualify. Crosby and her son canvassed furiously, knocking on doors and appealing to residents. Within two months, they had garnered 170 donations.

With a new solar panel on its way to Acton, Crosby needed a roof to put it on. She envisioned it on top of the middle school; the array would be the first source of renewable energy in the entire school district. Besides, she promised J.D. Head, the thing was only a few square feet in area—she’d only need a smidgen of roof space.

Head supported solar power in concept, but his annual budget wasn’t large enough to purchase all the energy for the district, pay his 85 workers, and invest in renewables. Even Crosby’s offer presented problems: he simply couldn’t let anyone drill down into his newly warrantied roofs, lest they spring leaks. He said no.

But Crosby was determined to find a way. The issue wasn’t the 1.9 kilowatts the panel would provide (enough to run a handful of light bulbs). The panel was a demonstration of purpose, a way to influence her community’s attitudes toward a global crisis.

Crosby told me this story on the evening of December 12, 2015, more than seven years after the panel-on-the-school-roof quandary. Earlier that day, 196 nations convened under the United Nations Framework Convention on Climate Change and reached the first comprehensive accord to cut global carbon dioxide emissions—an accord commonly known as the Paris Agreement. Crosby had attended an Agreement rally in Boston; when it was over, I hitched a ride home with her in the Nissan Leaf.

“The accord gives me courage and strength to go on,” Crosby told me from the driver’s seat. “I know I’m part of a network of people around the planet who are trying to understand this puzzle. People of tremendous power, intellect and capacity are stepping in and putting their shoulder to the wheel.”

While certainly a landmark, the Paris Agreement was not all that she and many other climate leaders had hoped for. Because the US Senate would have the right to evaluate (and likely reject) any regulatory mandates, the participating nations softened the agreement considerably, changing all the “shalls” to “shoulds.” Regulations often fail in this way. The gargantuan amounts of time and resources spent to design and pass them are put to waste by resistance from key politicians and industrial leaders.

But these limitations reinforced Crosby’s conviction that climate solutions have to be psychological as well as legal. Regulation plays a role, but law is several steps removed from

the daily choices we make. Beating climate change ultimately requires influencing people's behavior on a massive scale.

"You can set those goals but you can't achieve them without tools in your toolbox," Crosby said, as she pulled up to her neighbor's garage. "Certainly, behavioral strategies are one of the most important tools that exist," she said. She parked the Leaf and led me around to the front of the vehicle to indicate a socket above the bumper. Then she handed me the heavy recharging cable and I plugged it in.



Doug McKenzie-Mohr walked into his wife's home office with a metal safe tucked under his arm. To her inevitable question—"What's that?"—he replied matter-of-factly, "My social marketing chocolate bar retention strategy." Despite her skeptical expression, (what he described as a spouse's "are you sure you want to do what you're about to do next?" face,) McKenzie-Mohr was confident he had solved a pressing family problem.

"Sue has restraint, of which I have none," he explained sheepishly. She was capable of eating only several squares of a chocolate bar and saving the rest for later. He, on the other hand, would always eat all of his chocolate in one go.

Until they began living together, McKenzie-Mohr had sidestepped this problem by refusing to buy chocolate. But upon discovering the remnants of his wife's treats in the cabinet, he was unable to resist. Chocolate bar expenditures in the McKenzie-Mohr household tripled, Sue often found herself dessert-less, and Doug gained a few pounds of fat and guilt.

McKenzie-Mohr was determined to find a solution. After all, as a psychologist and consultant, changing people's behaviors was his profession. McKenzie-Mohr runs workshops around the world for people seeking to enhance their environmental efforts using psychological principles.

In one successful instance, he had managed to convince thousands of parents across Toronto to stop idling their cars while waiting to pick up their children from school. Through surveys and experiments, his team determined that parents would not turn their cars off to stop global warming, but that they would in order to improve the air quality for their children. By studying motivations and changing tactics accordingly, the team greatly reduced a large-scale source of climate change-causing emissions. He suspected that his chocolate challenge might have a similar solution.

His first idea involved Sue hiding her chocolate in various places around the house, so that the chore of searching for it would curtail his consumption. The strategy only worked for a few months. "Her motivation to hide chocolate was always surpassed by my motivation to find it," he said to me with a chuckle. They soon exhausted the hiding spots, and the plan unraveled.

This failure did not surprise him. Because behavior is so complex, first ideas rarely work, even for the professionals. But the failure was useful in that it uncovered his and Sue's motivations in that specific circumstance. Now he could tailor his intervention, making things much easier for her and much harder for him. That's where the safe came in. He might want chocolate, but not badly enough to spend hours fiddling with a safe.

When I asked him if the new strategy worked, he proudly told me that Sue was no longer so skeptical. The \$150 safe paid itself off in chocolate savings within three months of its purchase.



Even for small-scale, chocolate-related issues, human behavior is devilishly difficult to predict. Not only is it spectacularly nuanced, but it is also very challenging to study experimentally. While labs are great places to cleanly replicate procedures, they often isolate subjects from real-world factors that actually drive decision-making. Experiments outside the lab, while potentially more realistic, are fraught with uncontrolled variables that can obfuscate results and lead to false conclusions.

So when behavioral psychologist Bob Cialdini saw the little card folded neatly on the bedside table of his hotel room—Please Reuse Your Towel & Help Save the Environment—he realized his luck. A hotel makes a perfect real-world laboratory: a cluster of small, standardized microcosms in which the tenants leave a trail of behavioral data in their rooms. Guests can fold their towels neatly on a rack or toss them haphazardly on the floor without ever being aware they're taking part in an experiment. "You know those signs outside buildings that say 'This space available for rent,'" Cialdini asked me. "As an academic studying persuasion, I remember holding that little card in my hand, looking around the room and saying to myself 'This space available for test!'"

Cialdini's hotel epiphany led him to conduct one of the most influential and elegant experiments in the field of behavioral science. The design was straightforward: change the wording on the towel card and then count how many people reuse their towels.

Cialdini discovered that many hotels' default messages were not as influential as they could be. The vague "save the environment" request, for instance, had little to no effect. Messages promising a benefit—discounts on food, money donated to a charity in your name—were only moderately effective at best. So what works?

One of Cialdini's most successful signs read, "75% of our customers reuse their towels. Please do the same." This version yielded 25% more reuse than the default signs because, as Cialdini sees it, it invoked a norm. People look to others when deciding how to behave. If a person senses that most people are doing something, they are much more likely to do the same. The

effect is even stronger if people identify personally with those they are emulating. Thus, Cialdini's most successful application of the norm principle—"75% of the people *staying in this room* have reused their towels"—yielded a whopping 33% increase in towel conservation.

In 1984, Cialdini wove these findings together with other experimental results and with his personal experiences infiltrating car dealerships and restaurant wait staffs into a book. *Influence: The Psychology of Persuasion* has since sold more than three million copies.

"Finding them was just glorious!" said Crosby of her discovery of Cialdini, McKenzie-Mohr and other behavioral scientists. Since seeing *An Inconvenient Truth*, she has spent hours poring over their research. With particular fondness, she remembered the time, in 2014, when she got to meet McKenzie-Mohr, at one of his workshops in Cambridge, Massachusetts. She had her dog-eared copy of his book, *Fostering Sustainable Behavior*, tucked under her arm. As a thank you, she offered him a copy of her own published research in which he was cited.

"I depend on this tremendously important work as guideposts for what I'm doing," she told me earnestly. To drive her point home, she pulled from her files an extensively annotated photocopy of a study for which Cialdini and his colleague Wesley Schultz were senior authors. It was the first Cialdini study that she had ever read. Brandishing the coveted document, she said, "I went around, and I still go around, quoting this article."



Back in 2007, before her encounters with McKenzie-Mohr, Cialdini, and Schultz, Crosby and J.D. Head (the facilities director) wrangled over the placement of the solar panel until they reached a compromise. The small array ended up on the hot dog stand next to the school football field. It generated only enough energy to power the scoreboard, but it sparked a new wave of energy politics in Acton. The town formed a Green Advisory Board and Crosby was elected co-chair. From that vantage point, she discovered a certain piece of data that has been nagging her ever since.

"The schools spent \$2.1 million a year on energy!" she said, pausing to let the number sink in. "I knew that number ... teachers didn't know it. Administrators didn't know it. No one! Meanwhile they're trying to scramble around and do bake sales for \$100. As a taxpayer, I was flabbergasted. It's like a money pipeline flowing in the background, 24-7-365."

And that was just the money. Even worse was what the money bought. Every dollar was paying for electricity from the state grid that ran mostly on fossil fuels. "I used to tease the utilities manager that he has the largest carbon footprint in Acton. And it was true," Crosby said. The schools were emitting approximately 3,200 metric tons of CO₂ emissions a year,

thickening the atmosphere, trapping heat around the planet and driving climate change. So that \$2.1 million became Crosby's target, and she was determined to learn how to reduce it.

In the winter of 2009, Crosby strode into an elementary school in the middle of Cranston, Rhode Island, to observe a workshop. The library to which she was led was so overheated that the windows had been opened to let the heat out. "There were so many things wrong with this picture, I couldn't even!" Crosby laughed, swiping her hands before her for emphasis. On the library carpet, students sat in a circle, repeating mnemonics to help them memorize different kinds of renewable energy.

Crosby was not the only observer. She found herself next to woman whose badge identified her as an "Energy Educator." Her role, Crosby learned, was not only to monitor and advise on her district's energy finances, but to apply behavioral science to change how its workforce used energy. "I thought, 'What!?' That's what everything in me is dreaming of," Crosby exclaimed. She had found a professional, evidence-based way to fight climate change that applied what she instinctively understood as a community organizer.

The more Crosby explored, the more hopeful she became. She discovered several other school districts across the country that had carved hefty slices off their energy expenditure by addressing behavior alone. She got in touch with their teachers. She shared what she had learned from McKenzie-Mohr, Cialdini, and other researchers with J.D. Head, who also became intrigued. With Head's blessing, Acton's new Green Advisory Board obtained funding for an energy manager position under his supervision. Crosby applied and got the job.

When she sat down with the Acton Superintendent of Schools to present her ideas, her ten-percent energy-use reduction plan raised eyebrows. The superintendent admitted that he had never tried behavioral interventions before, and he didn't want to make any commitment the district couldn't reach. "Let's shoot for five percent," he suggested, hesitantly.



As Crosby navigated Acton's energy politics, a University of Chicago economics professor and a Harvard Law School professor pushed behavioral science fully into the limelight. In their 2008 bestseller, *Nudge*, Richard Thaler and Cass Sunstein explored how to influence people's decisions by shaping what they call "choice architecture." Choice architecture is the physical and psychological environment in which people make decisions. The people who design and build those environments are known as choice architects.

The term suits Crosby well. She sought to redesign the situations in which people throughout the school district choose, often unintentionally, to harm the climate. If successful, her choice architecture could nudge them away from actions that harm and toward those that help.

However, choice architecture has remained an underutilized weapon in the arsenal against climate change. Though it is cheap, fast-acting and adaptable, we more often turn to tenuous international treaties, astronomically costly updates to infrastructure and politically fraught, slow-to-materialize command and control regulations. But all climate solutions ultimately depend on changing behaviors, which makes choice architecture an inevitable part of the way forward. The recent application of behavioral science in other fields, like health, marketing, product design and public policy, makes the nudge approach all the more promising.

Cialdini attributes the recent wave of interest partly to some academic fence-jumping. “The insights of social psychology,” he told me, “are being embraced by the field that is the most respected by decision-makers—economics.”

The embrace was tentative at first. In 2004, Cialdini discovered a typo as he leafed through the program of an international conference on social influence and policy for which he was a guest speaker. He was listed not as a psychologist, but as a “behavioral economist.” When Cialdini notified the conference organizer of the mistake, the organizer dropped his voice to a whisper. “To be honest, I couldn’t have gotten funding from my superiors to bring you here as a psychologist. However, as a behavioral economist, that was justifiable,” he said. Cialdini heard the exact same justification for the same mistake at a similar conference later that year.

Behavioral economics is a young branch of economics, but is the benefactor of much wisdom from the field of psychology. It was arguably born in 2002, when Daniel Kahneman, a behavioral psychologist at Princeton University won the Nobel Prize for his studies in mental shortcuts. Yet the award he earned wasn't in psychology or behavioral science, but in economics. While classical economic models assumed that individuals always make rational choices, Kahneman had documented countless instances in which they do not.

For instance, imagine that you are car dealer trying to sell a \$40,000 car to a client for as much money as you can. “How much is having your own ride worth to you?” you ask. “\$80,000?” Suggesting such a high number is psychologically powerful because it will frame the rest of the conversation. Your client might negotiate the price down, but because their expectations have been psychologically anchored to the \$80,000, getting the car for \$60,000 will feel like a steal.

This so-called *anchoring bias* is mathematically irrational. The only thing that should influence someone's opinion of the price is how valuable the car is to them. But the brain is systematically fickle in such situations. By rigorously substantiating these mental quirks, Kahneman shook economic theory so profoundly that he earned the prize.

The longer he studied, the more humorous Kahneman found the imaginary, ever-rational characters inhabiting economic models. They were so unrealistic that he took to calling them “econs,” a different sort of being than real “humans.” Comparing the behaviors of econs and

humans in various situations has since become a classic thought experiment amongst his colleagues.

An econ, for example, would have very little difficulty saving for retirement. Given the option of investing in a 401k, the econ would calculate how much money her employer would match, how much she would save from the tax deferral, and how much money she needs now and for retirement. She would then use that information to invest the optimal percentage of her earnings in that 401k immediately. While some humans approximate this, even accountants find those calculations formidable. Others, due to a lack of know-how, memory, or willpower simply don't do it at all.

Kahneman's conclusion, that we humans are fundamentally different from econs, caught the eye of future *Nudge* author Richard Thaler. Thaler decided to study under Kahneman in 1977, and over the following decades, Thaler and Kahneman dedicated themselves to the study of how humans make such decisions. As they did, an old field of research was rebranded: behavioral science became behavioral economics.

With that came solutions to many behavior-based problems, including the 401k conundrum. As Thaler explained in *Nudge*, humans considering retirement options often fall victim to *status quo bias*, or a lack of motivation to change. While an econ would drop everything to instantly sign up for an optimal 401k program, many humans are more likely to accept the default setting of not having a 401k, even though that choice is suboptimal.

So Thaler designed a nudge. He changed the default setting so that new employees must opt out, rather than opt in to their savings plan. This simple change was enough in several studies to get more than 90% of new employees to begin their savings within the first few months of employment, while previously only about half had done so. Since then, countless companies and government institutions worldwide have made this tiny change, which cost them next to nothing and has greatly benefited their employees.

To Cialdini, that signifies a real sea change. "The evidence suggests that behavioral scientists do have credibility now," he said. "And," he laughed ironically, "we're often invited to international conferences." It's been almost a decade since he's been mislabeled in a conference program.



One of the beauties of nudges, including climate nudges, is that they are easily scaled up by making small tweaks to pre-existing systems. This is exemplified by one of the cheapest, most widespread climate nudges, one that may currently be sitting in your mailbox—the comparative energy bill.

In the early 2000s, psychology professor Wesley Schultz of California State University, San Marco collaborated with Cialdini to reduce household energy use. Their research team distributed various messages to homeowners, asking them to use fans instead of air conditioning to “save the environment” or “prevent black outs” or “save money.” These messages had little to no effect. But their fourth message—“77% of your neighbors reported that they use fans instead of air conditioning to save energy”—inspired measurable reductions. According to Crosby’s heavily annotated photocopy of their research, this message cut household energy use by approximately 11%.

But the study revealed something even more fascinating to Crosby. When asked, subjects thought that norm-based messages would be completely unpersuasive, even though the data clearly indicated otherwise. In Cialdini and Schultz’s language, subjects were naive to the persuasive power of norms. Like much of choice architecture, norms can influence people whether they are aware of it or not.

Since then, several research groups and startups (*OPower* is the most prominent) have conducted hundreds of studies with tens of thousands of households to apply these principles to the design of energy bills. Many small psychological tweaks to the graphics and text really add up; they reduced the average household’s energy budget by 3%. While 3% may seem modest, if the whole US gets on board, that’s equivalent to taking the entire state of Nevada off the grid.

The bill employs several climate nudge techniques. Simple wording and clear, prominent figures helps the bill payer actually notice their energy consumption. In psychology lingo, this improves the *salience* of the energy use.

The bill also establishes norms by showing the neighbors’ energy use—but with a clever twist. The usage of the most energy efficient neighbors is listed first, psychologically anchoring the bill payer to that the benchmark. Kahneman’s anchoring and Cialdini’s norms deal a potent one-two punch, causing people to identify with and then strive for a norm established by the most efficient households.

To prevent the most efficient residents from regressing back to more consumptive habits, the bill provides them with moral affirmation: “GREAT” with two smiley faces. That simple addition worked wonders. Those who received that bill each month stayed green throughout the years that the studies lasted.

While powerful, 3% is only a start. As it stands, the bill is unable to tell users whether they should focus on replacing the old refrigerator, limiting their shower time, or something else entirely. And the bill arrives only once a month, weeks after the energy is consumed. What if it

could target the behaviors that people most need to change? And what if the report could provide feedback, not months after the fact, but in the moment that the behavior occurs?



At the Swiss Federal Institute of Technology in Zurich, postdoc Verena Tiefenbeck has discovered just how much focus and timing matter in choice architecture. Armed with that discovery, Tiefenbeck can reduce an entire household's energy consumption by an average of 22% with a nudge that fits in the palm of your hand.

Named after the Greek goddess of the rising tide, the Amphiro A1 is a small water tracker that attaches to the head of a shower. Powered by the flow of water, Amphiro presents the showerer with the temperature of the water and a real time tally, liter by liter (or, in the US, gallon by gallon), of how much water they are using. In the upper corner of its screen, a small letter grade flashes, first an A+, then A, then A- and so on. The hotter the shower, the faster the grade drops. Meanwhile, at the bottom of the screen, a little polar bear stands on an iceberg, which slowly shrinks over the course of the longest showers.

While a typical showerer may lazily enjoy the relaxing warmth of the running water, those confronted with the Amphiro do not dillydally. When I asked Tiefenbeck how she managed to make such an effective climate nudge, she responded concisely: "Field studies." There was not a single aspect of Amphiro that Tiefenbeck and her colleagues left to chance.

Their approach was to add or subtract elements on the screen, presenting them in different ways and altering the times that they were displayed. Then, they installed the various models into households and compared the impacts of each one. With every iteration, Amphiro's nudge factor increased a little more.

Tiefenbeck first wanted to verify that a liter counter was the most effective way to tally energy use. So she compared that with counters tracking the carbon-dioxide emitted or the kilowatt hours of energy used to heat and transport the water. When the data spoke in favor of the liter counter, Tiefenbeck was not surprised. After all, she said, "my friends don't spend their day chasing kilowatt hours."

Tiefenbeck was less sure how participants would respond to the non-verbal cues—the letter grades and the polar bear. In principle, non-verbal communication is easy to understand and thus helps make information more salient, like the smiley faces on Schultz's energy bill. But if the participants found the images to be guilt tripping or overly negative, they might ignore the nudge entirely.

Again, the data spoke loud and clear; the cues were very effective. Surveys showed that the polar bear was particularly well liked. In fact, her lab has become known as “the meter with the polar bear” people.

Not all of her predictions were confirmed. One model flashed the final readings of the previous shower at the start of the next one. She had predicted that would, in her words, “get a little competition going,” in a way reminiscent of Cialdini’s towel signs. However, it had no effect.

Are we less influenced by a single data point from one shower than by the averages on Cialdini’s signs? Or do we care less about the behavior of people we know (as most of our shower sharers are)? These are mysteries the field has yet to untangle.

Meanwhile, Tiefenbeck’s steady, scientific approach continues to examine how well Amphiro works in different cultural contexts. She eagerly awaits the data from team members beyond the Swiss borders, in Singapore and Korea.



In September of 2010, Crosby began her dissection of her school district’s \$2.1 million energy bill, seeking to split it into understandable, manageable parts. First, she turned to the high school, the largest, most energy-consuming building in district, determined to find out where all that energy was going. It was to be a difficult task, but she had help. On a Saturday morning, she and a group of seven student volunteers made their way through the front doors into the empty salmon, green and yellow-tiled lobby of Acton-Boxborough Regional High School.

They were armed with clipboards, paper, pencils and Kill-A-Watts—grey, GameBoy-sized outlet extensions that display the amount of electricity consumed by any appliance plugged into them. Crosby vividly recounted the scene that ensued. “I remember walking into the principal’s office and literally diving under desks with kids. Turns out they had never been in the principal’s office before,” she said. Excited, the students tested every device they could lay their hands on—coffee makers, printers, computers, copy machines, refrigerators, pencil sharpeners—and began gathering the first device-specific usage data in the history of the district.

It became clear to Crosby that she had happened upon the perfect team, its youthful energy harnessed to competence. Beyond the principal’s office, the students knew the school inside and out and began mapping it for Crosby. A maze of “energy pipes” began to appear in her minds’ eye, pipes that they would follow to “faucets” in every corner of the building. In many cases, they found faucets left running.

“One of the kids suggested, ‘you know that crazy computer lab? Let’s go check that out.’ The others answered ‘Oh, yeah. The crazy lab!’” Crosby re-enacted their discoveries fondly,

swinging her arms as though she were chasing after the kids. “We run down the hall, open the door and all 25 computers are completely lit up, running 24-7-365, and IT had no idea.”

Patterns emerged. A plugged in pencil sharpener at rest drew almost no electricity. However, a coffee maker, storing water at boiling temperatures for the instant one wants coffee, drew quite a bit. Devices controlled by remotes, ready to be turned on at any moment, drew large amounts of energy even when powered down. These devices became prime candidates for being plugged into a power strip and switched off.

Identifying these patterns turns out to be a critical step in any climate nudge. According to McKenzie-Mohr, the first step to changing environmentally damaging behaviors is to “choose the right behavior.”

People often assume that the right behavior is the one with the highest impact. That’s exactly what the Canadian government did in 2004 when it piloted the “One-Tonne Challenge,” which encouraged Canadian homeowners to reduce their carbon emissions by a ton a year. The program was a flop. McKenzie-Mohr thinks that is because it targeted the wrong behaviors, like replacing old furnaces or reinsulating homes. These changes do have a huge impact, but they require so much time and effort that people rarely do them.

That was not so for Tiefenbeck’s Amphiro. Showering may be slightly less carbon-intensive than home heating and cooling, but anyone can easily shower quickly. It was a behavior made for nudging. Luckily for Crosby and her team, powering down appliances was also a doable target behavior.

As students shared their findings, faculty and staff cocked their ears. Several months into their data gathering, even the principal responded to a student presentation at a faculty meeting. “I was fretting all day about having left my phone charger plugged in at home, when really what mattered was not turning on all the lights in my office, which I prefer anyway!”

To further nudge the faculty, Crosby and her team began leaving thank you notes for teachers who had thoroughly powered down their rooms and suggestions to others on how to do so. Many faculty members responded enthusiastically.

Their enthusiasm demonstrated why Crosby considers schools to be the perfect place to nudge. Schools contain higher levels of social interaction than almost any other setting. Additionally, “everything is so badly underfunded that people are clear that turning the lights out in February means being able to buy books in September,” she explained. But most significantly, “all the adults in the building are wired to be responsive to young people.” Where a request from a supervisor in a corporate office for employees to turn out lights might feel meaningless, a request from a student to a teacher is powerful.

The approach was so effective that Crosby extended this work to the other Acton schools. By 2012, these behavior-based interventions had collectively cut the entire district's energy budget by 13%, saving over \$200,000 a year. The once-skeptical superintendent personally thanked Crosby's team of high school students for freeing him enough money to hire additional staff.

But all was not rosy. While many faculty members eagerly powered down, a few were not happy. To them, it felt inappropriate, invasive, even manipulative for students to monitor and nudge adults this way.

One Monday, several months into Crosby's experiment, a refrigerator full of food was found unplugged in one of the storage rooms. Food had rotted. Fingers were pointed. Several blamed Crosby's team of students for the spoiled food. According to Crosby, they couldn't have been responsible, since she was the only one with a key to that part of the building and she had not let anyone in. Nevertheless, Crosby and her students suddenly faced the discomfort that nudges sometimes inspire.



One hot summer day in 2010, Rob Shirkey found himself in bumper-to-bumper traffic on the 401, a fourteen lane super-highway in Toronto. His maroon Mazda 3 was surrounded by thousands of unmoving cars, shimmering in the heat. Knowing he'd be there for a while, he hit the dial on the radio and leaned back against the black fabric seats to listen. The radio host and his guests were discussing BP's mismanagement of the Deep Water Horizon oil spill. To Shirkey, the conversation about the disaster seemed far away. Until it didn't.

He was suddenly beset by an eerie vision, as though through X-ray goggles, of the countless tanks of petroleum encircling him. Some of them, he realized, even his own, could be carrying fuel from the very well that was currently spewing millions of gallons of oil into the Gulf of Mexico. Yet the radio voices never mentioned the role consumption plays in environmental disasters.

To help people make that connection, Shirkey devised a climate nudge, along with a place to put it. "Where else do fossil fuels actually flow through the palm of our hands?" he asked me rhetorically. The answer was: gas-pump nozzles. In 2013, he founded Our Horizon, an NGO with a mission to put environmental warning labels on pump nozzles in service stations across Canada and beyond.

One of his labels shows a baby caribou galloping after its mother. The red text beneath it reads "WARNING: Use of this fuel product contributes to climate change which may put 30% of species at likely risk for extinction." Another says "WARNING: Use of this fuel product contributes to smog which may cause asthma and other respiratory problems in children." The

idea, Shirkey explained, was to confront people directly with the consequences of using fossil fuels in the moment that they purchase it, like a warning on a pack of cigarettes.

His concept eventually caught the attention Emily Kelsall, a seventeen year old from West Vancouver, British Columbia. Kelsall, an articulate young woman with short red hair, explained to me over Skype that these labels remind consumers of their role in climate change. "I'll read a news article and it's like, 'Climate change. Oh right! That's a really big problem. I've got to do something about that.' And then we sort of push it aside as something the government will take care of. But by putting the warning labels on the gas pumps we begin to recognize that we're a part of this too."

Kelsall found the idea so compelling that she decided to champion it in several local municipalities. In June of the same year, she formed a one-woman delegation to the City of North Vancouver and asked the city council to require the labels on all the gas pumps in the city. On November 16, the council unanimously passed a bylaw stating just that.

Even as things progressed in North Vancouver, Shirkey's nudge was met with resistance in other places. Many other municipalities rejected the idea. Various online articles about Our Horizon were sullied with hateful comments declaring the labels a ridiculous waste of resources and telling Shirkey to insert gas nozzles into various bodily orifices. Shirkey shrugged off the trolling. But could labels that controversial be an effective nudge?

"Warnings aren't for free," said Marc Green, a Canadian psychologist who, after years of research, now professionally assesses warning labels. While warnings are meant to nudge people to be careful, Green said, people often don't pay attention to them because there are so many. Each new warning, he said, "poisons the well and contributes to people's general disregard for warnings."

McKenzie-Mohr agrees that large numbers of nudges can end up competing for our attention. Ideally, he thinks, people shouldn't be asked to change more than five or six behaviors at once. Beyond that, each nudge will yield diminishing returns, because people suffer from what psychologists call "decision fatigue." Making decisions (such as deciding to change a behavior) requires so much mental energy that, when forced to do it repeatedly, people make poorer, less rational decisions. Sometimes, they even succumb to *status quo bias* and stop making decisions at all.

Tiefenbeck found Shirkey's warning strategy interesting, but had some concerns about its timing. When you arrive at a gas station, she explained to me, you've already committed to filling the car. Though the warning may prompt you to think about climate change, at that point it could be too late to immediately affect choices. When she programmed Amphiro to delay its feedback to the end of a shower, it was much less effective.

Since the passing of the label legislation, several North Vancouver city council members have also expressed concern about the label design. Caroline Jackson, the council's sustainability manager, worries that overtly negative messages on the labels could turn people off to the issue. "If you provide only a negative message, that can work for certain segments of a population...but it can actually alienate others," Jackson said.

Behavioral economist David Tannenbaum shared a similar concern with me over Skype late one Thursday morning. "People don't like it when they think you're doing Jedi mind tricks to them," he said. Tannenbaum studies people's attitudes toward nudges as a postdoc at the University of Chicago. He found that, as Crosby and Shirkey experienced first-hand, some nudges can really raise people's hackles.

This is particularly true in political situations when people feel they are being coerced into doing something against their political beliefs, what Tannenbaum calls *partisan nudge bias*. In one elegant experiment, he identified a nudging policy backed by both the Bush and Obama administrations and wrote two nearly identical descriptions of it, changing only the name of the president who endorsed it. Then he presented study subjects with one of these descriptions and asked them to rate how unethical, manipulative or coercive it was. Unsurprisingly, more people rated the policy as more coercive if it was endorsed by the opposing party. (Coincidentally, the policy in question—the 2006 Pension Protection Act—provides incentives for companies to change their employees retirement default to 'enrolled,' a nudge for a nudge.)

Yet, for the warnings specialist Marc Green, the problems with warning labels go beyond the fact that a label can turn people off the issue. Warning labels often mask the true solution to a problem—eliminating the actual risk. If fossil fuels are dangerous ways to power cars, he said, cars should be redesigned to run on something else.

When dealing with any hazard, Green explained, designers, engineers and even the World Health Organization follow three basic steps: First, try redesigning so that the hazard no longer exists. If that doesn't succeed, create barriers that protect the user from the hazard. If those approaches don't work, and only then, use a warning.

From this point of view, Green sees every warning as a failure to address the true problem. Warnings give leaders, in his words, "a false sense that you are actually doing something about a hazard." Warnings simply offload responsibility from people in power to others who must either adjust their behavior or suffer the consequences.

When I asked Green whether Shirkey's warning label could effectively nudge against climate change, he answered, "Not a chance in hell."



Perhaps Green's strategy is the better one. Could the world redesign its energy grid around something other than fossil fuels? Such an approach would certainly be more forceful than a nudge.

A tax on carbon emissions, for example, is more accurately called a "push." The carbon taxes currently being levied in British Columbia, Sweden, and Chile, rig the finances and thereby push people to use less non-renewable energy. The approach is stronger than a nudge because there are significant monetary consequences for those who don't change their ways.

Legislators could even take things a step further by prohibiting the emission of greenhouse gases—a shove. Historically, such shoves have been quite effective. Since the Clean Air Act was passed in 1970, the EPA boasts a 69% reduction in six common air pollutants—the "Dirty Half Dozen"—despite a growing population and increased demand for fossil-fuel-based energy. Requiring companies to find a better way drove them to innovate new methods for removing those chemicals from their emissions.

The world is not yet ready to limit CO₂ production outright. The most promising opportunity to do so, the Paris Agreement, instead produced something much more nudge-like.

However, there are unique advantages to the Agreement as it stands. As McKenzie-Mohr explained, pushes and shoves "have this laser-like focus. You get that particular behavioral change but you get nothing else." If someone could be fined for idling a car in a particular school parking lot, that fine would be unlikely to affect whether people idle their cars in other places, because as Cialdini put it, "that incentive can be seen as the only cause of the behavior."

In contrast, nudges can build on themselves and on each other. In McKenzie-Mohr's car idling experiment, his team offered drivers a small window sticker to advertise the detrimental effects of idling. Those who put the stickers on the window became rolling advertisements for the cause, and were also more likely to reduce their own idling. Small public commitments, like stickers, can motivate people to act concordantly with the messages they are promoting. In Cialdini's words, "if you see yourself acting according, not to some external motivator, but to something internal, then you're likely to behave comparably in other settings." This allows nudges to perpetuate themselves beyond their original contexts.

To similar effect, the Paris Agreement required countries to publically declare goals to which they will try to adhere, laying groundwork for more ambitious commitments in the future.

When issues are as complex and controversial as climate change, nudges are also more feasible than shoves. In a recent study, *Nudge* author Cass Sunstein found that people generally prefer nudges to shoves because they can push back against them, if necessary. That very contingency in the Paris agreement allowed the US to sign on.

Tannenbaum agrees that, despite occasionally raising hackles, nudges are more often seen as freeing than coercive. A little nudge isn't strong enough to get people to do something they really don't want to do, Tannenbaum explained.

"If I asked you, 'Would you rather have a million dollars or drink a bucket of pig vomit?' regardless of how I set the default, regardless of how I write up the question, you're going to give the same answer." Nudging will never be on par with Jedi mind tricks.

Since passing the requirement for gas pump labels, the city council of North Vancouver has been in the throes of negotiation, particularly over the negative tone of Shirkey's original design. Caitlin Hill, a recently graduated master's student at Royal Roads University, threw herself into the middle of this debate, examining how the literature and public opinion comes to bear on Shirkey's label design. In a series of discussions with citizens, she found that while they may respond to its guilt-tripping strategies, there are two conditions. First, any statistics on the label must be credibly sourced. Second, labels must specify concrete, realistic ways for customers to reduce their use of gas, (a step that Cialdini agreed will be critical for their success).

Jackson, the sustainability coordinator, is currently trying to synthesize Hill's research, the voices of local activists like Kelsall, and the feedback from gas station owners, to come up with a revised label design. It's slow going, but Shirkey's brainchild may be evolving into something promising.



The last time I pulled into a gas station, I found myself nudged on all sides. Enormous glowing prices loomed overhead. As I opened the door to my little Chevy Prizm, the smell of gasoline was masked by the tempting aroma of coffee wafting from the convenience store. Gaudy ads on

Successful climate nudges ...

1. target the right behavior, one that is both high impact and easy to change.
 2. make the target behavior salient, by providing information about it.
 3. use simple language and non-verbal cues.
 4. give real-time feedback on the behavior.
 5. have climate-friendly defaults.
 6. establish climate-friendly behavioral norms.
 7. make people feel obligated, e.g. by obtaining a public commitment.
 8. take advantage of common mental shortcuts like anchoring bias.
 9. morally affirm climate-friendly behaviors.
 10. are delivered by a credible source within a social context.
 11. prevent opposite effects by carefully navigating negative information and partisan nudge bias.
- and most importantly,
12. are refined using results from field studies.

the pump's LCD screen jockeyed for my attention, offering me grocery points, speedpay options and a free oil change. So nudged was I, that, despite my new-found obsession with climate and psychology, I completed the whole transaction without once thinking about emissions, or even gasoline. While my wallet was nudged this way and that, my environmental conscience remained untouched.

That was no coincidence. Shirkey had told me that, in the 1920s, one would first fill a glass tank atop the pump with gasoline to measure one's purchase before transferring it into the vehicle. In those days, one could, in his words, "have a sense of 'Oh. Where did this come from? Where does it all go?'" But, without the salience offered by the glass tanks, I failed to ask those questions. The absence of that climate nudge amid all the others shifted my thinking away from carbon emissions toward other things.

In *Nudge*, Thaler and Sunstein state that there is no such thing as "neutral" design in choice architecture. I have never felt that truth more strongly than as I pulled away from that gas station. Whether random or intentional, present or absent, helpful or harmful, nudges are inevitable.

Current choice architecture is not doing the climate any favors. For drivers filling up at the gas station, teachers absent-mindedly leaving their classrooms, and showerers luxuriating in the warm water—psychology is currently stacked against the sustainable choice. How would that change if the choice architecture nudged the other way?

If imagining an answer is difficult, achieving it will be even harder. There are many things worth nudging for and each inspires an array of approaches to accomplish it. However, in North Vancouver, an experiment is underway. One community seeks to transparently debate, design and pilot a climate nudge. And the true power of Shirkey's idea was to set that dialogue in motion.



Mrs. Acheson was still in hushed conversation with Crosby at the back of her 6th grade classroom when the children began streaming in. As though a volume knob had been turned, the voices of the Gates Elementary School Green Team swelled to rambunctious levels as the students made for their preferred seats at the pods of desks. With a nod to Crosby, Acheson assumed teacher mode, strode to the front of the class, clasped her hands in front of her chest and patiently brought her students to attention.

Today's Green Team meeting was very important, she said. Given that February was fast approaching and March was going to be "Energy Awareness Month," this group of students

had no time to spare. Their first task was to brainstorm in small groups about ways that the school might save energy.

At the pod nearest me, Meghana, her hair held back with a pink clip, led the charge. "I think what we should do is make sure things are turned off," she said, indicating the cart full of charging ChromeBooks by the classroom door.

From across the small desks, Priya countered, "But they have to be charged so they're ready to use."

"Yeah, but I think we should only charge it when we need it." Meghana explained. "If you don't use it a lot, then it's just there, using energy." The group agreed and Acheson added 'Turn off ChromeBook cart when not in use' to a growing list on the whiteboard.

The chaos of the brainstorm was replaced with undivided attention when Crosby stepped to the front of the room carrying a long, slender box. "I keep saying Z-Wave to people, and none of the smart people I talk to have heard of it," she explained to the children secretively, placing the box on the table in full view and pulling back the cover. It was filled with small, sleek pieces of white plastic, each of which Crosby had labeled with a handwritten number on a bright yellow strip of tape.

She pulled a white cube out of the box and held it up for all to see. There was a socket on one side and prongs on the other. When she plugged it into the wall, a thin light strip around the boarder began to glow a pleasant green. Not unlike the Kill-A-Watts that Crosby had used with the high-schoolers, this Z-Wave Outlet Sensor could measure the energy use of any object plugged into it. Unlike the Kill-A-Watt, it could report the data continuously to an online database using radiowaves of a unique length and protocol.

Crosby walked over to Acheson's computer and entered a URL. Several graphs swiftly appeared on the smartboard at the front of the classroom, each showing data from a different Outlet Sensor plugged into a power strip at the back of the room. The kids looked intrigued. Crosby, who knew the psychological power of these images, could hardly hold back her excitement as she skipped back to the box.

She then pulled out a smaller object, two inches along a side, with a transparent dome across the top and a USB cord running out from the base. "And these are our Multisensors," she announced as she carefully scooped up the dangling cord with her other hand. "Can anyone remember what they can measure?" Hands went up and the list began: temperature, humidity, motion, and (from one young boy in the back) "luminescence." "Yes, exactly, more commonly called light," Crosby clarified. A well-placed Multisensor could read the overall energy output in a given room at any time of day. Now it was time to set them up.

The Green Team took to their tasks with verve. Some began clicking their way around the database. Others continued adding their energy saving ideas to a class GoogleDoc. Meanwhile, Crosby and a team of five huddled around the box of Z-Wave equipment, discussing how to distribute the sensors throughout the fifth and sixth grade wing.

Mariah, sporting a thick brown ponytail, took up a clipboard and the Z-Wave Sensor Tracking Sheet, where she would record the location of each device. As each student removed a sensor from the box, she neatly penciled notes into the appropriate cell. Multisensor #5—Ms. Conley’s room. Outlet Sensor #8—Ms. Stenson’s ChromeBook Cart.

With Outlet Sensor #11 in hand, a blond boy named John made an excited series of silly steps toward the nearest classroom door in his Timberland boots. “OK, let’s go to Narnia!” he shouted over his shoulder.



A half hour later, the last of the students raced off to their next class, leaving Crosby and me alone in the hallway. Acheson’s voice rang out clearly from her room—“You won’t be timed on this but in the future you will be”—the sign that class had turned back to the upcoming statewide assessment. Thanks to Mariah’s assiduous record keeping, all the distributed sensors were accounted for on the Tracking Sheet. Only a few sensors remained in the box, unused.

Even after all that work, Crosby smiled matter-of-factly. “Whether it’s going to produce anything useful we don’t know,” she said.

But her voice betrayed palpable determination. This project at Gates Elementary is even higher stakes than her previous work because Eversource (once NSTAR) is peering over her shoulder. Since 2008, utilities like Eversource have partnered with the Massachusetts state government to finance energy efficiency projects. If a project meets the state’s specifications, then the utilities can use state funds to subsidize it.

Typically, these funds are reserved for infrastructural improvements like reinsulating homes. But if the Gates project succeeds and yields rigorous enough data, it may qualify for the subsidy. This may be the first time in the nation that behavioral interventions in a school will earn state energy efficiency money, thus making it a litmus test for similar projects in the eyes of utilities and government.



On September 15, 2015, President Obama issued Executive Order 13707, “Using Behavioral Science Insights to Better Serve the American People.” It declared in broad terms that he

intended to use the White House's fledgling Social and Behavioral Sciences Team (SBST) to improve policy. SBST was modeled after London's Behavioral Insights Team, which was formed in 2010 to apply the findings in *Nudge* to public policy and projects, earning them the informal moniker, "The Nudge Unit." (*Nudge* author Thaler has personally advised the two teams from time to time.) These teams, and others like them, are springing up around the world and making their own successful contributions to policy. The SBST, for example, managed to increase the number of high-needs students matriculating to the colleges that accepted them with a simple series of text message reminders.

SBST has yet to target climate change. But to Crosby, Obama's executive order was most significant in that it validates the concept of behavioral intervention. "This is recognition that there is an emerging science. It's not just an accumulation of old wives' tales. It's worth paying attention to," she said.



Before leaving for the day, Crosby distributed the few remaining devices: one on a table in the middle of the hallway, a few in the art teacher's room ("Oh no ... I probably use a lot of energy in here!" the art teacher tittered nervously) and a pair in the main office.

Though nothing is certain until the experiment is complete, Crosby could already envision the surefire sign of her success. "Imagine the kids coming in after the weekend," she said, "checking the readouts from the Z-Wave equipment and going up to the custodian and giving him a high five for having turned out all the lights in the library." She didn't know at that point that, just a few months into this experiment, Gates would reduce its energy use in the student wings by 11%.

While I returned my visitor's badge, Crosby asked the secretary for permission to monitor the office printer. "Oh, I'm all for it," said the secretary, getting up from her seat to investigate Crosby's rearrangement of the power strip in the corner of the room. "My electric bill is sky high," the secretary explained. She knew this because of those "bills you get in the mail that say 'You're using this much and your neighbors are using this much.'" She wasn't fully convinced the numbers were accurate. "How could our usage be so much higher than our neighbors?" she asked rhetorically. As Crosby stood to put on her jacket, the secretary asked her where in town she could get cheap, energy-efficient bulbs.

As she and I made to leave, Crosby paused midstride, eyeing the big grey Xerox machine by the door. Half to me, half to herself, she muttered, "I'd love to catch that copier." But the box tucked under her arm, once full of sensors, was now empty. With a deep exhalation, she strode toward the exit. "Another time."