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“...makes me human and makes me a fool; it gives me all the world and exiles me from it.”

—URSULA K. LE GUIN

The Decades-Long Quest to Overcome “The Human Factor” in Avalanche Deaths

By Greg Rosalsky

On a stormy Sunday in February 1995, 37-year-old Steve Carruthers strapped on his skis and headed into the Wasatch Mountains near Salt Lake City, Utah. It had dumped almost two feet of snow that weekend, and Carruthers and two friends wanted to ski powder in the untamed wilderness of the backcountry. The Utah Avalanche Center’s advisory warned there was a serious danger of avalanches that day. The new snow, it cautioned, had fallen on a slippery crust of ice, and steeper slopes could slide. But these skiers were seasoned veterans, and they believed they could avoid trouble.

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The snow-covered backcountry is a difficult place for human psychology.
Heuristics create a sort of autopilot for our brains, and, most of the time, they work remarkably well. But this autopilot system can steer us in directions that, in a rational state of mind, we would never choose.

In the aftermath of Carruthers’s death, McCammon dove into the psychology literature and began exploring theories and evidence for how heuristics affect human decisions. He was particularly interested in research by the psychologist Robert Cialdini on how advertising firms, cult leaders, and other antagonists exploit heuristics and steer us where they want us to go. But the antagonist McCammon now set his sights on wasn’t a person or a business. It was something lurking under the snowy face of a mountain, an invisible layer within the snowpack—“a weak layer” —which is the most common contributor to avalanche deaths.

‘The mountain may not be deliberately trying to fool you,’ McCammon says. But lurking beneath its beautiful and tantalizing slopes is something that can. McCammon began to use the term “heuristic traps” for the faulty processes that can blind backcountry skiers and snowboarders to obvious dangers and lure them into peril in the mountains. While there were avalanche experts before McCammon who had recognized that human error could play a role in backcountry accidents, the avalanche community lacked rigorous research showing the severity of the problem and effective methods to try and combat it.

And so, inspired by his friend’s death, McCammon began leading a double professional life. By day, he continued his career as a meteorologist, helping to predict and avoid avalanches after that, “Tremper says. “That avalanche changed my life.”

Tremper went on to study avalanches at Montana State University, earning a master’s degree in geology in the process. Meanwhile, he continued working at Bridger Bowl, becoming a ski patroller tasked with avalanche control.

On mornings before the ski resort opened, he would strap on a pack filled with explosives and head to the resort’s black diamond and double-black diamond runs, chucking bombs at the avalanche-prone slopes to clear them of deadly threats to resort guests. “I got to do all these trial-and-error experiments—and I learned so much about avalanches,” he says.

Tremper, however, was an experienced ski racer. He was young. He was cocky. And he decided he could instead “ski cut” the couloir, zipping across the slope at a 45-degree angle, far enough to outrun an avalanche if the slope did end up sliding. But as he tried to cut across the slope, he realized he had made a horrible miscalculation. He heard a muffled “thunk,” and, as he says, it was like someone yanked a rug from underneath him.

The avalanche took him on a ride down the couloir before slamming him into a tiny tree. He quickly grasped the tree and held on for dear life, as a mighty river of snow moving at highway speeds flowed around him. The tree broke, and he continued down the slope, gasping for air as he fought to swim above the surface. He began to brace for the worst as he submerged into the snowy torrent. But then, all of a sudden, the river stopped. Tremper’s lower body was stuck in avalanche debris, but his head and arms were free. He was able to slowly chip himself out with the shovel he had in his backpack.

The resort ended up naming the couloir “Tremper,” in honor of the lucky survivor.

“I wanted to learn everything I could about avalanches after that,” Tremper says. “That avalanche changed my life.”

But Tremper’s new job as a backcountry avalanche forecaster entailed investigating avalanche accidents. And data point after data point slowly brought a startling reality of the backcountry into light. It was a reality in which skiers and snowboarders with ample avalanche training routinely died in circumstances that could have been easily avoided. Tremper and Fredston began incubating ideas that have come to be known in the avalanche community as “the human factor.”

“Jill and Doug weren’t social scientists, and research on the human factor was still in its infancy at the time,” Tremper says. “But Fredston and Feleson began incubating ideas that have come to be known in the avalanche community as ‘the human factor.’”

“I think we were the first ones to say there were unconscious errors in judgment that routinely led people to their death,” Tremper says. “We learned that most avalanche deaths came from what we called the ‘sheep’s syndrome.’”

They called the rush to get the first powder tracks on a slope “the lion’s syndrome.” They called the tendency to blindly follow others “the sheep’s syndrome.” They called the rush to get the first powder tracks on a slope “the lion’s syndrome.”

But, Tremper says, at first he didn’t buy the idea that flaws in human cognition systematically led adventurers to their peril. “I was trained in the physical sciences,” he says. He saw the problem of avalanches through the lens of physics and topography and snow science. He had assumed that most deaths could be prevented by simply educating recreationists about snow dynamics.

But Tremper was like a lot of people back then, even those trained in social science. At that time, in the 1980s, most economists and many other social scientists had fallen out of love with the social science theory, which embraced mathematical models of human behavior in which people were perfectly rational. The implication of these models was that all people needed was information and resources, and they would always make the best choices for themselves.

By then, Tremper was the director of the Utah Avalanche Center, which is based in Salt Lake City. He had hired Yates as the avalanche forecaster for the Moab area, which is on the eastern side of the state. Yates had been pretty inexperienced in avalanche forecasting at the time, but he was a Moab local and expert skier with tons of backcountry experience in the La Sal Mountains, a mountainous range of snow-capped peaks that towers high above the red rocks of eastern Utah. Tremper believed Yates could grow into an effective avalanche forecaster for the region.

In the winter of 1992, the Moab area spent weeks in a snow drought. In early-to-mid February, it finally began snowing again. And on February 12, the skies cleared and a couple feet of fresh snow beckoned Yates and five other skiers into the La Sal Mountains. “They were thirsty for powder,” Tremper says.

The group began the day climbing a low-angle, avalanche-safe ridge up to a subsummit...
known as Pre-Laurel Peak. Standing at about 11,000 feet, they gazed upon an expansive winter-scape glistening in the sun. Yates was in high spirits, intoxicated by the conditions. He insisted they ski down the south face of the peak and then head into Talking Mountain Cirque, a gorgeous, upper-elevation bowl that looks like a humongous white amphitheater.

At the base of Talking Mountain Cirque, the slope is gentle, well below the 30-degree threshold where terrain can avalanche. But above that are three steep faces that can—and often do—avalanche. It was absolutely dangerous to go there in the snow conditions the skiers faced that day.

“They thought they were okay with the slope angle they were on,” Tremper says. “But I know that Mark knew that you can pull these things down from below—that these collapses can propagate uphill. And when that collapse reaches terrain steep enough to slide, then it’ll slide down on top of you. I mean, he knew that.”

Two members of the group had taken an avalanche class from Tremper only weeks before. The survivors recounted these two voicing concerns about heading into Talking Mountain Cirque. They said it was a dangerous and stupid destination when there seemed to be instability in the snowpack. But Yates was the Moab avalanche forecaster. He was the alpha dog. And he kept insisting they would be okay; that they would keep traveling on gentle slopes and stay safe.

The group ultimately deferred to Yates. And, as they traveled to the cirque, they ignored all signs of danger and confirm to themselves that their chosen route was safe. He could see the “sheep syndrome” when the group blindly followed Yates into trouble. He could see that Yates had been crowned as the group’s expert and that the group deferred to his judgment, as flawed as it was. And Tremper could see what social scientists call confirmation bias in the group’s over willingness to disregard signs of danger and confirm to themselves that their chosen route was safe.

From that point on, Tremper’s view of the human factor is dramatically different. The survivors had been traveling with a group of expert skiers who had avalanche training. It was clear they should have known better.

At the time of the accident, Tremper was actually overseas, in Japan. He had been traveling there to help launch an avalanche center. This was before smartphones and widespread use of the internet, so Tremper didn’t hear about the accident until he returned. And when he did, the news jolted him. He began poring over the details of the accident and hearing the play-by-play from survivors.

“That with that Mark Yates accident—all the things happened that Jill Fredston and Doug Fesler told me about,” Tremper says. “There were all these human factors going on.”

Using the terminology developed by Fredston and Fesler, Tremper could see evidence of “the lion’s syndrome,” or the race to get fresh powder. He could see the “sheep syndrome” when the group blindly followed Yates into trouble. He could see that Yates had been crowned as the group’s expert and that the group deferred to his judgment, as flawed as it was. And Tremper could see what social scientists call confirmation bias in the group’s over willingness to disregard signs of danger and confirm to themselves that their chosen route was safe.

From that point on, Tremper’s view of the human factor completely changed—and he got serious about warning the avalanche community about it. “I realized that we need to start talking about human factors in our avalanche classes, addressing them specifically,” Tremper says.

Within two years, he joined Jill Fredston in presenting a paper about the human factor at the International Snow Science Workshop, an annual event where avalanche experts meet and discuss ideas. “They urged the group, which included officials from 13 countries, to recognize that ‘perception traps’ could cloud backcountry travelers’ judgment, and they urged educators to start talking about the human factor in avalanche courses. That year, the workshop was held at Snowbird in Utah, and Tremper recalls their presentation attracting a good amount of attention. But Tremper also recalls many avalanche educators being hesitant to change their curricula and delve into the flaws of human psychology. “It was kind of controversial in those days because a lot of people who taught avalanche classes really didn’t want to talk about it,” Tremper says. “They were just like I had been. They thought people made logical decisions. They thought we just have to teach students about the science of avalanches and they’ll automatically figure it out.”

And that’s pretty much where the avalanche community stood before Ian McCammon got involved. There was a growing awareness that human factors contributed to avalanche deaths, but most authorities weren’t sure how serious the problem was and what they should do about it. Within a year of that workshop, however, Ian McCammon’s friend Steve Carruthers died in circumstances similar to Yates’ death. And McCammon would soon join the fight, creating a bridge between the world of avalanches and the world of social science.

In the aftermath of Carruthers’s death, McCammon began a quest to understand the cognitive errors that could lead people to their death in the backcountry.
McCammon was finally able to overcome the resistance that Fredston, Fesler, and Tremper had faced when broaching the human factor. Now a critical mass in the outdoor community recognized that deep-seated flaws in human psychology continuously lead people to their peril in the mountains.

In "The Human Factor" chapter of his popular avalanche textbook, Staying Alive in Avalanch Terrain, Bruce Tremper credits McCammon’s FACETS framework with revolutionizing the avalanche community, and his work proved to be a clarion call that authorities could no longer ignore. His research was soon cited all over the world in mainstream news outlets, like NPR, The New York Times, and virtually all ski publications. He urged avalanche educators to reform how they teach students and Incorporating the FACETS framework into their classes. And McCammon was finally able to overcome the resistance that Fredston, Fesler, and Tremper had faced when broaching the human factor. Now a critical mass in the outdoor community recognized that deep-seated flaws in human psychology continuously lead people to their peril in the mountains.

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effective human factors education must do more than provide a laundry list of heuristic traps: It must give people simple, viable tools to perceive the truth in the mountains. Like FACETS, this tool goes by a memorable acronym that doubles as a metaphor: ALPTRUTH, which urges backcountry adventurers to turn their brains off autopilot and think rationally about the kind of information about avalanche danger. In the lexicon of behavioral economists Richard Thaler and Cass Sunstein, it’s a nudge. "Just say: 'Look for these things, and, if you see them, be very careful about your decisions.'"

Like FACETS, ALPTRUTH has been widely embraced by the avalanche community. All kinds of outdoor organizations and companies use it to promote public safety. It inspired the creation of Avalanche Canada’s portable decision-aid tool, the Avulator, which they market to backcountry travelers. Teton Gravity Research, an extreme sports media company, and Dynafit, a maker of ski boots and clothing, have sponsored online educational videos using the acronym. Jones Snowboards offers split-board poles with graphics of obvious red flags of avalanche danger. The American Avalanche Institute declares to the public that both ALPTRUTH and FACETS are "two acronyms that can save your life."

Psychological baggage out of the decision," McCammon says.

When Ian McCammon began publishing papers in the early 2000s, the outdoor community had witnessed a decade in which avalanche fatalities rose to scary new heights. But in the 20 years that followed, the number of fatalities stayed pretty flat, with an average of about 27 per year in the United States. At the same time, backcountry winter sports have exploded in popularity, so while the absolute number of fatalities hasn’t gone down, deaths have gone down significantly on a per-capita basis. This suggests that educators are doing a better job of training adventurers how to recreate safely.

That said, the 2020/2021 winter season saw a record-breaking 37 avalanche fatalities in the United States. With COVID-19 pandemic increasing demand for outdoor activities, the backcountry witnessed an unprecedented surge of newcomers. Many had worried these newbies would haphazardly enter the mountains, sparking an explosion of avalanche fatalities. But, in retrospect, it wasn’t really the newbies who proved to be the biggest problem. As McCammon had found in his dataset back in the early 2000s, more often than not, it proved to be experienced backcountry adventurers who got themselves in the most trouble. You could call it the avalanche paradox.

The snow-covered backcountry is a difficult place for human psychology. Snowy slopes are idyllic and exhilarating, and psychological research has long struggled to analyze the avalanche paradox.

Th stands for thaw instability. Has there been any recent warming of the snow due to sun, wind, rain, or higher air temperatures? Rapid warming contributes to the likelihood of a slope avalanche. Using his dataset on past avalanche deaths in the United States, McCammon analyzed how many of these seven obvious clues were present in accidents before the victims got in trouble. And, he says, the average accident had five of the clues present before the avalanche.

McCammon imagined an alternate universe in which the skiers killed in avalanches had paid attention to the obvious clues in front of them and avoided avalanche terrain on the days they perished. He envisioned them using ALPTRUTH to create decision-making rules in which they picked a certain number of identifiable clues as a kind line in the snow: if we see this number of ALPTRUTH clues today, we will turn back and not ski avalanche terrain.

In a 2004 study, he and Pascal Haegeli crunched McCammon’s dataset to figure out the most effective rule. They found that if skiers had set a rule to not ski slopes when they could identify four clues, 77 percent of them would have lived. And if skiers had set a rule of avoiding slopes when they could identify three clues, 92 percent of them would have lived.

McCammon’s data may have been imperfect, but it strongly suggested that a clue-based decision aid could significantly mitigate carnage in the mountains. He saw ALPTRUTH as a kind of prototype. He hoped his research would spur others to take up the mantle and conduct more empirical analysis of how to prevent avalanche accidents. Some were skeptical of McCammon’s findings, but many other researchers began following in his path.

For example, in 2012, a group of Norwegian scholars analyzed all avalanche accidents in Norway between 2005 and 2012, comparing the effectiveness of different decision-making tools. They concluded that ALPTRUTH was the most effective. They found that 50 percent of all avalanche accidents in Norway would have been avoided had skiers chosen to not ski when they could identify more than four clues. Further, they found that “100% of the accidents would have been avoided if the skier had not been carried into an avalanche.”

The goal of ALPTRUTH is to get backcountry travelers to stop using faulty heuristics and emotions to make decisions in the backcountry. It urges them to instead objectively process information about avalanche danger. In other words, ALPTRUTH tries to get people to turn their brains off autopilot and think rationally about the information in front of them.

In the lexicon of behavioral economists Richard Thaler and Cass Sunstein, it’s a nudge. “It allows you to reframe things and get the psychological baggage out of the decision,” McCammon says.

McCammon cites research by psychologist Gary Klein, who pioneered thinking on what he calls a "premortem." A postmortem, of course, is something a coroner does after someone dies to determine the cause of death. A premortem is an exercise in which people imagine a hypothetical future in which things go horribly wrong. They then use critical thinking to dissect the causes that could lead to such a scenario. Using ALPTRUTH, McCammon says, backcountry travelers can conduct a simple premortem. Before or during your trips into the mountains, he says, you should imagine a future in which you or your partners die in an avalanche. Then look at those seven obvious clues of danger. Are they present? If they are, how stupid will your decision look if there is an avalanche?

A major advantage of ALPTRUTH, McCammon says, is that it is designed to be easy and fast. Before backcountry travelers depart on an adventure, they can run through the list of factors quickly. "You can give someone a nine-second avalanche course in the parking lot just with these seven clues," McCammon says. "Just say. 'Look for these things and, if you see them, be very careful about your decisions.'"

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But the backcountry is a place where you can ski the same slope 99 times and not get hurt—unless maybe that’s just because you’ve been very lucky. The repetition can lull you into overconfidence, where your brain goes on autopilot, making decisions without critically assessing potential dangers. But weather conditions can dramatically change—and a persistent weak layer of faceted snow or other avalanche dangers can form in the snowpack. And, on the 100th time you head down your favorite slope, *whamp*! you’re a goner.

To overcome all the psychological problems that people could encounter in the backcountry, Tremper says again and again in his textbook, “The system is the solution.” Tremper says that paid backcountry professionals, like ski guides and heli-skiing outfits, have figured out really effective systems for navigating the hazards of the mountains. They rely on careful analysis of the snowpack. They have team meetings in the morning, running through checklists about conditions and doing pre-morrtex exercises. They identify specific areas where it’s safe to travel and then stick to that terrain. They have alternative plans ready if on-the-ground conditions are worse than expected. In the evening, they debrief about their decision-making that day and assess how they can improve it in the future. Their rigorous systems explain, Tremper says, why backcountry professionals have remarkably low fatality rates despite their frequent outings in high-risk terrain.

But these are paid professionals with bosses and clients and bureaucracy and money on the line. A major challenge in the backcountry, Tremper says, is that most excursions are undertaken by non-professionals who must vet their decision-making themselves. The challenge, he says, is getting people to voluntarily adopt systems to keep them safe.

“When you’re a professional operation—and people’s paychecks depend on abiding by the rules—then you’ve got some leverage,” Tremper says. “But how do you implement such a system in a peer setting? I think that’s the holy grail of this whole human factors thing.”

Before he retired, Tremper sought to improve how the Utah Avalanche Center and other avalanche centers communicate dangers to the public. “An avalanche forecaster in Colorado, Dale Atkins, told me this for years: We don’t have an avalanche forecasting problem. We have a marketing problem.” Tremper spent much of his career trying to solve this marketing problem. He, for example, created daily advisory reports that were easy—and even fun— to read. He used eye-catching graphics to communicate danger. He got the center to use social media and YouTube to educate the public about problems in the snowpack.

Tremper has long been concerned about the official warning systems that many avalanche centers use. In the United States and Canada, local advisory systems have adopted what’s called “The North American Avalanche Danger Scale.” It communicates dangers to the public with five levels: low, moderate, considerable, high, and extreme. Most accidents occur on days when centers warn that the danger is “considerable”— and Tremper has long suspected that one contributor to the problem is that the word “considerable” does not effectively communicate danger. “I hate that word,” he says. “I wish I could wave a magic wand and change it—and I’ve sat on committees for years trying to get that done.” He prefers a system adopted by many European countries, which communicates danger more simply with colors and numbers.

While there is still much room for improvement, avalanche institutions have made tremendous progress tackling the human factor. For example, the American Institute for Avalanche Research and Education, the main organization for educating American backcountry travelers, now embeds many of McCammon’s ideas and analyses in its avalanche courses.

Interestingly enough, McCammon’s FACETS framework has found resonance outside of the backcountry. He’s taught professionals like doctors, attorneys, and astronomers how heuristic traps can lead them into trouble. He says he gets them to think about bad decisions and mistakes they’ve made in the past. And then he has them run a “FACETS test,” asking them to think about which heuristics potentially led them astray. Often, he says, they uncover patterns in their decision-making weaknesses—and he’s hopeful that this will help them spot and override their defective decision-making rules going forward.

In 2016, the American Avalanche Association bestowed McCammon with their highest award. “It is impossible to quantify the number of people who have not perished in avalanches due to Ian’s research and his impact on avalanche education and methodology,” the presenter said. “However, what we can say is that Ian has effected a sea change in the way in which we talk not only about snow, but about ourselves.” People will, sadly, continue to make dumb decisions in the mountains that cost them their lives. But thanks to people like Ian McCammon—who have not perished in avalanches due to their efforts—backcountry adventurers now have better tools and a more informed community working to nudge them towards safety.