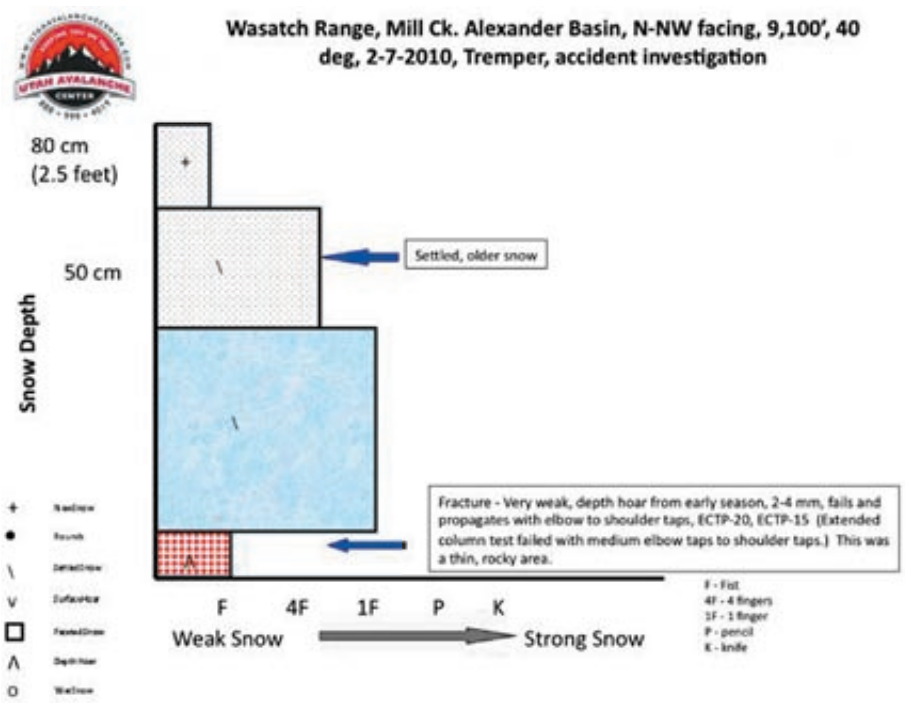
Brett Kobernik, UAC forecaster, examines the weak layer in the flank fracture. This photo shows the deepest section which was about 3' deep – the majority of the fracture was around 1.5' deep. *Photo by Bruce Tremper*



packed me up and lowered me to the waiting helicopter. They were fast and efficient, and as they were setting up the anchors for the litter to lower me, I was administered morphine, which provided immediate relief, and I had a sense that I might survive.

Hindsight

In hindsight, the human factors that contributed to this accident are quite clear. John and Clay had a gut instinct that the area was not safe to ski. Our friendship provided a level of deference to me, since I had been in the area the day before without incident. There was also a feeling of not needing to question or ask for clarification on exactly what we were planning to ski, as things were going smoothly up to that point. We read and understood the forecast, but did not apply it to the terrain in Alexander Basin. The terrain had all of the suspicious characteristics: it was an upper-elevation slope, it was steep with slope angles over 40 degrees, and the snowpack was thin – less than 4' deep in the spot where I triggered the slide. I saw the terrain as something that could be managed, but failed to see the consequences of what could happen if a slide occurred. No blatant signs of instability were present, which allowed us to enter the area, but the terrain did not allow for a course correction once we got in there. My curiosity to figure out the terrain was just too strong. I had been reinforced just enough on the tour in the same area the day before to go back and try it again.

Clearly this accident could have been prevented. The area can be skied safely, but not in low-snow years or during times of considerable instability. Knowing when an area can be skied safely takes time and a great deal of patience to develop. We missed a lot of cues on that day. The terrain and the snowpack provides the information for us to interpret when we are determining where and when to ski; it's up to us to get it right.

Matt has been skiing the Wasatch backcountry since the early '90s. He has completed a Wilderness EMT program and a level II avalanche training course through the American Avalanche Institute. He lives in Salt Lake City with his wife Jennifer and their two cats. He currently spends his time relearning how to walk after breaking both his legs (see xrays, right).

Xrays taken February 7, 2010, reveal Matt's right tib/fib break and left broken femur.

Beyond the Human Factor:

A Matter of Semantics?

Story by Ian McCammon

I used to think the words we used for it didn't matter.

Human factors, human error, the human factor – what we called it didn't seem important. What did seem important was how otherwise smart people could be lured into believing a slope was safe when it clearly wasn't. And what mattered was figuring out how to prevent it.

But as I explored this problem in my research and my teaching, I began to suspect that the words we use actually *do* matter. Like an iceberg on the ocean surface, words are often clues to unseen assumptions that lie beneath. Those assumptions can limit our understanding of problems and handicap well-intended solutions in ways we don't always understand.

For example, the very term "human factor" anchors us in at least two subtle but important assumptions. The first is a value judgment courtesy of the late industrial revolution, when the term first came into usage. The human factor almost invariably referred to the unpredictability of humans as a barrier to an otherwise logical and orderly manufacturing process. The human factor was an undesirable influence to be minimized and, if possible, eliminated.

In the avalanche world, this assumption was enshrined in the common belief that if only we could keep our emotions in check and be rational enough, we would make better decisions in the face of avalanche danger. The problem with this belief, as we now know, is that emotional engagement and intuitive insight are often essential to effective decision-making involving complex risks.

The second assumption is that the term "human factor" frames the decision to enter an avalanche slope as a convergence of independent and relatively static elements: physical factors such as terrain, snowpack, and weather contrasted against psychological factors that act on the individual or the group.

This approach certainly has appeal from an educational perspective, judging by the longevity of teaching devices like the Avalanche Triangle introduced by Jill Fredston and Doug Fesler in the 1980s. As a conceptual tool for novices, it's handy to simply file the (very) long list of human delusions, weaknesses, and biases under the human factor.

But deconstructing a problem is not the same as solving it, and simply naming the ways in which a decision can go awry does little to prevent it. This is in part because deconstruction typically overlooks interactions between factors, and thus provides no insights for failed decisions that were more than just the sum of their parts. As the Greek philosophers used to say, you can divide a cat into parts and study each of them, but when you put them all back together, well, you don't get the same cat back.

The factor interaction problem is easily appreciated by anyone who has ever tried to fix a warped bicycle wheel. The quick fix is to crank up the tension in one spoke so that it pulls the wheel more or less true. This solves the problem in the near term, but when the overstressed spoke eventually snaps, you're worse off than before. By focusing on the human factor alone as the source of our problems in avalanche terrain, I suspect we are setting ourselves up for the expectation of a quick fix – an expectation with a rather rich history of disappointment and disaster.

Fortunately, there is another perspective on the human-factor problem. Starting in the 1970s, and coincidental with the rise of systems engineering, some avalanche researchers and practitioners have advocated a more holistic view of how avalanches and humans interact. This perspective encompasses not only individual factors but also includes factor interactions and their dynamics.

As is typical of our field, many fascinating research questions are just waiting to be explored using relatively simple methods. For example, the four factors of humans, terrain, snowpack, and weather combine in at least 11 ways. Which interactions have received the most study and why (a potential metastudy)? How do these interactions commonly manifest themselves (quantitative/qualitative analysis)? Which interactions are most prevalent in accidents (data mining) and how can those interactions be addressed (cognitive ergonomics design)? Ah, to be a master's student again.

An even more extensive toolbox of research methods exists in systems engineering and cognitive systems research. In fields as diverse as emergency medicine, aviation, and tactical command, tools such as cognitive work analysis and system optimization have brought about significant advances in human performance in the face of risk. And it is worth noting that these successes are occurring in fields where the term "human factor" as a working explanation for accidents was retired long ago.

We're not likely to solve the avalanche problem overnight, but I suspect that a worthwhile first step might be freeing ourselves from assumptions and paradigms that have hindered our efforts in the past. The research tools already lie before us, and with a little creativity and hard work they can be adapted to help us make better decisions in avalanche terrain.

So perhaps words do matter. If nothing else, they are a good place to start.

Ian McCammon is a researcher living in Salt Lake City. He believes that humans are pretty good at making risky decisions, especially when compared to the alternative. He is deeply indebted to his students, colleagues, and mountain partners who continue to provide deeper insights into how good decisions can be made better.