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Real-World Adventures in Science, part 1: Aconcagua

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by Kevin Schmidt

[In the lab, studies of decision-making are done with highly artificial tasks in tightly controlled situations (is this sine-wave grating an A or a B?). However, our theory of how multiple memory systems contribute to decision making is supposed to apply to complex, real-world, high-leverage decision making. Getting data on how well that works means venturing out into messy, uncontrolled contexts and struggling to collect data with definitions of the independent and dependent variables we hope make sense. Kevin's story is the first example of what we expect will be a series on adventures, lessons learned and maybe even ideas for formal controlled research inspired by case-study, semi-anecdotal data in the wild. – PJR]

On December 19, 2017, I found myself with a decision to make. I was standing on the side of Mount Aconcagua in Argentina at an altitude of 19,700 feet, about three thousand feet from the summit of the highest mountain in the Western Hemisphere. It was a snowy whiteout and the winds were extremely strong—this was Aconcagua's infamous Viento Blanco (Spanish for the White Winds). In addition to the inclimate weather, I no longer had a functioning camping tent or stove as they had not survived the strong winds. I had been forced to rely on the kindness of other climbers headed for the summit to shelter overnight and melt ice for water. The decision was: attempt the summit in the somewhat dangerous weather conditions or return back down the mountain now?

Planning for this trip had started many months earlier. Together with some climbing colleagues, we had even been sleeping in low-oxygen tents for four months as part of training to pre-acclimatize to high altitude conditions. That wasn't a fun experience and the feeling of chronic sleep deprivation was only partly balanced by some solid longitudinal data on changes in blood oxygen levels of the climbing team following overnight hypoxic simulations. There was also the travel to Chile, the bus to Argentina, and days climbing up the mountain to this point.

Turning around meant not being able to follow through on all the invested effort. The Air Force had built a social media campaign around the climb and everything. But making a mistake and attempting a dangerous summit has substantial risks. As Paul pointed out later, we learn by trial and error in the lab, but high altitude mountaineering is often not a place where you can learn from a really bad choice…you might not get another chance at life or death decisions.

The theoretical lab model is that decision making is a mix of deliberate processing and intuitions. We had a climbing plan, we trained for a wide variety of situations, we tried to think everything through in advance. But then there are intuitions in the moment, where you have a gut sense of a reasonable or an unreasonable amount of danger. Decisions are supported by a mix of these explicit and implicit processes and we are interested in how the mixing of these processes is affected in real circumstances.

An idea we had was that low oxygen, high altitude climbing might asymmetrically impair explicit decision-making compared to implicit decision-making processes. As a proof-of-concept, I tried to explore this idea with some concrete data by bringing tools for cognitive assessment on the climb.

An Android tablet was used to administer cognitive tasks to our climbing team at different camps up the mountain. Cognitive data was successfully collected at elevations over 18,000 feet! Working memory, the explicit ability to hold things in mind, was indexed using a digit span task. In contrast, a test of simple reaction time was used to signify the goal of assessing implicit processing. The cognitive data will not be interpreted as this was not systematic data collection, but this effort highlighted the need to develop an accurate index of the implicit system, which is fundamental for multiple memory systems research to progress in this domain.

Heart rate and GPS data were also recorded throughout the excursion using the Garmin Fenix 3 to complement the cognitive assessment. This wearable platform provided the ability to collect critical physiological and contextual data about the climbing team for improved safety monitoring and novel data analytics. The Android tablet and Garmin Fenix 3 were supplemented with an external USB connectable battery pack and a portable solar charger for multi-day data collection. Hardware testing on the mountain found that battery life was a limiting, yet manageable factor in this endeavor.

This proof-of-concept venture demonstrates the feasibility of collecting real-world cognitive and physiological data during high-altitude mountaineering. Back on the mountain, our climbing team made the decision to not push through the harsh weather for the summit of Aconcagua. Decision making here depended on the interaction of multiple memory systems, and a bad decision could have prevented us from safely returning to basecamp. It is imperative to understand how multiple memory systems interact during decision making in extreme environments, because this could be the difference between life or death.

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