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Decision making for wilderness leaders: strategies, traps and teaching methods

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Abstract

One of the more enduring beliefs about decision making is that if we think hard enough, and are rational and objective enough, we can make better choices. This advice works well when our decisions are clearly defined and time is plentiful. But in wilderness settings, our decisions are less clear and time is short, and the standard advice is not only cumbersome but, in some cases, dangerously misleading. In this paper, I'll show why classical decision methods don't always work, and I'll review research findings from two emerging areas of decision science: heuristics and expertise. For each method, I'll show how and when wilderness leaders can best apply them, and I'll review strategies for teaching them to novice leaders

Introduction

On January 12, 1993, three skiers left Vail Ski Area headed for the backcountry. The avalanche hazard was posted as high for that day, but the three friends had just completed an avalanche course and were confident they could find safe powder skiing beyond the area boundaries. They had been warned about the unstable conditions by the Vail ski patrol, and as they passed the avalanche warning signs at the backcountry access gate, they saw all around them evidence of the danger: a dozen fresh slides on nearby slopes, collapsing and cracking in the snow under their skis, and heavy drifting on unstable slopes already loaded almost to the breaking point.

In their quest for untracked powder they descended, as a group, into a steep, wind-loaded gully – a classic terrain trap. The avalanche they triggered caught all three skiers, deeply burying and killing one of them.

Accidents like this one raise uneasy questions about the role of education in how people make decisions in avalanche terrain or other wilderness settings. Although education probably has little effect on the amount of risk a person is comfortable taking, what role does it play in how people perceive and manage those risks? Is it enough to simply give students raw information about the hazards, as many avalanche safety and other wilderness skills programs do? Or are there learnable decision tools that can improve how students convert what they see into action?

In this paper, I'll review three decision tools that have emerged from decision science and various branches of psychology. I'll show how these tools can be applied in wilderness settings, and I'll look at why they work and why, sometimes, they don't. Finally, I'll review the current knowledge of the best ways to teach these skills.[1]

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Let's start by taking a look at the standard advice for making decisions.

Analytic decision making

When most of us think about decision making, we imagine a process that goes something like this: define your goals, gather information; compare alternatives, then decide (figure 1). By moving methodically from one step to the next, and backtracking if necessary to refine a previous step, this approach to decision making implies that we will eventually arrive at the best possible decision given the information at hand.

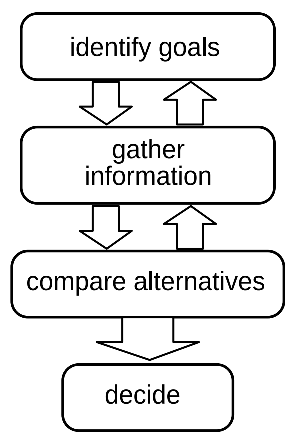


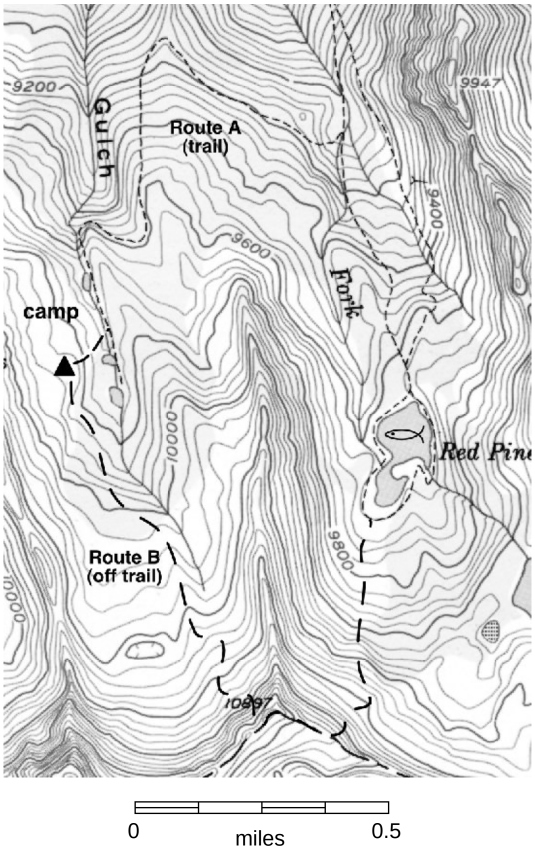
Figure 1. Analytic process for decision making.

This approach, called analytic decision making, is appealing because it breaks down difficult decisions into smaller, more manageable tasks. It seems logical and objective. Best of all, it appears to be sound advice that could be used in almost any situation. After all, the same basic process has been extremely successful in solving problems in the sciences, engineering, economics, and a variety of other disciplines.[2]

Here's an example of how analytic decision making could be used in a wilderness setting:

Example: Choosing a route

Imagine that you're leading a group of students from camp to a day of fishing at a nearby lake. You have about 6 hours to make the trip, and the group wants to climb peak 10897 on the way. You need to decide if the side trip will fit into your schedule.



You identify two alternatives: route A is 1.8 trail miles, with a loss/gain of about 600 feet. Route B is 1.5 off-trail miles, with a gain/loss of about 1,000 feet.

Using standard formulas for travel time[3], you find:

time A = 1.8 mi at 2 mi/hr + 600 ft at 2000 ft/hr = 1.2 hr

time B = 1.5 mi at 1 mi/hr + 1,000 ft at 1000 ft/hr = 2.5 hr

If you go to the lake via the peak (route B) and return by route A, you'll have just over 2 hours left for fishing

This simple example illustrates the power of the analytic approach to re-frame a decision (should you climb the peak?) into very specific terms (is there enough time?) so that alternatives can be compared and a sound choice made between them.

Given the precision and logical appeal of the analytic strategy, it's no surprise that many people have suggested that this is how *all* decisions should be made. Popular books explain how to apply this strategy to almost any decision[4] and, until recently, analytic approaches have been considered the standard against which all other human decision processes were compared.[5]

Well, there's theory and then there's practice. Much to the chagrin of classical decision scientists, average people rarely use analytic decision making for day-to-day decisions. Worse, even after people have been extensively trained in the analytic decision process, they are not any more likely to use it than untrained decision makers.[6] Studies of state-of-the-art analytic decision training aimed at business managers, physicians, military commanders, airline pilots and college students consistently show the same result: even high-quality analytic training has little effect on how these people make decisions. Even more proof that people avoid analytic decision making can be found in advertising, where analytic arguments are almost never used to induce people to buy a product or service. Instead, advertisers resort to more indirect (and effective) methods of influencing consumers' decisions.[7]

To understand why individuals don't routinely use a decision strategy that should, in theory, yield the best possible answer, we need to take a closer look at the assumptions underlying the analytic approach.

Unrealistic Assumptions

Analytic decision making, in its ideal form, makes three assumptions that render it awkward for most decisions. First, it assumes that we can achieve greater certainty by examining the relevant data closely enough. In other words, it assumes that key information is available and consistent and that our alternatives are all readily apparent. But most real-world problems, especially in wilderness settings, don't fit these criteria.

For instance, let's reconsider our route finding example in the context of risk management. While route B gets the group to the top of the peak (a desired result), it is not without hazards. The steep slopes below the peak will probably present rock fall hazard, both on the way up and on the way down. There may be exposure to serious falls. And depending on the weather, the route may expose the group to lightning, wind or rain. And since actual travel times may be longer than estimated, these risks could be compounded by longer exposure times.

The group leader in this case is facing a number of complex questions: How much emphasis should she place on safety (avoiding hazards), and how much on giving the students a quality experience (climbing the peak)? How likely is it that someone will get hurt during the climb? Should the group split up?

As the leader looks more closely at each question, the analytic process of breaking difficult questions into smaller pieces produces more uncertainty, not less. There are now multiple conflicting goals (safety and travel time versus quality experience), the information is incomplete (the actual hazards of each route are only suspected and not precisely known) and there are alternatives with unknown consequences (splitting up the group).

At this point, an experienced leader would make an intuitive decision based on the anticipated hazards of route B (estimated from their prior peak climbing experiences) and the group's abilities (estimated from her prior experience with similar groups). But her decision arises from her expertise (a fundamentally different process, as we'll see), and *not from the analytic process itself*.

A novice leader doesn't have the option of relying on experience. The only information she has is uncertain (possible rock fall hazard, student abilities) and as she seeks more information to reduce the uncertainty, it only increases the complexity of the problem (How much loose rock constitutes a hazard? What if one of the students stumbles?) If the only decision tool she knows is the analytic strategy she'll be paralyzed – none of the steps in figure 1 can be completed. Unless she has outside guidance from a more experienced person, the analytic approach alone cannot solve her dilemma. In short the analytic process works for leaders with experience; it does not work for novices.

A second assumption of the analytic decision process is that each decision maker has the time and capacity to focus their mental energy exclusively on the decision at hand. As we know, wilderness leaders face decisions ranging from as simple as "where do I put the tent?" to as complex and critical as "how do I manage this group safely in exposed terrain?" If every decision was treated analytically, with each alternative painstakingly weighed against all the relevant data, very little would ever get accomplished. Analytic decisions are just too time-consuming to do properly. A further complication arises from the limited capacity humans have for consciously processing incoming data. Psychologists have found that we can hold somewhere between five and nine pieces of information in our minds at one time.[8] Without memory aids (like writing things down) we have little hope of weighing all the relevant data in a real-world decision.

Finally, the analytic decision making approach assumes that people are motivated solely by the desire to be accurate. As we'll see later when we examine rationalization and heuristic traps, plentiful research indicates that people are also highly motivated to protect their self-esteem and be accepted by the group.[9] These motivational factors may act alone or in combination but at best, the decision maker is only vaguely aware of their presence and influence.[10] The result is that the process of weighing information as relevant or not is far from objective, and in reality the analytic decision strategy is much less "rational" than it might at first appear.

The three assumptions of analytic decision making – certainty, capacity and accuracy – greatly undermine the purported power of the analytic process. Thus it's no surprise that inexperienced novices avoid the strategy as cumbersome and less accurate than other methods, and that the best analytic decisions are made by experts who have already developed intuitive judgement skills.[11] For novice leaders who are on their own, there is very little to recommend the analytic decision method for wilderness or other unstructured settings.

Rationalization Traps

Ironically, two quirks of human nature that weaken the analytic decision making process also blind us to the limitations of the strategy. In the 1950's, social psychologist Leon Festinger developed the theory of cognitive dissonance, which maintains that people will go to great lengths (including exposing themselves to great hazard) in order to maintain a self image of rational, logical consistency.[12]

Since analytic decision making has become the *de facto* standard for rational decisions and people, after all, want to see themselves as rational, it's no surprise that the analytic decision process is often co-opted to justify a decision that has already been made using less formal means. Studies of financial analysts, physicians, business managers, and military commanders have demonstrated what most of us recognize as a fairly commonplace phenomenon: much "decision making" is no more than a rationalization of a decision that we have already made intuitively.[13]

In wilderness settings, this rationalization process can undermine entire sequences of decisions made by novices. Dietrich Dörner, a noted German psychologist, has found that when decision makers face unfamiliar and complex situations, they sometimes will make decisions that are sequentially consistent, even when those decisions are clearly wrong.[14] In these cases, the motivation to be accurate (make the best decision) is superceded by the motivation to protect one's self-esteem (appear competent and consistent). For the novice wilderness leader, this means that one or two small mistakes, if left unchecked, can snowball into far more serious mistakes, even when there is plenty of evidence to the contrary.

A second quirk of human nature blinds us to the opportunity to learn from others when their analytic decisions fail. When people read about accidents (such as the one at the start of this paper), a common reaction is to attribute the victims' behavior to their abilities, personality, or motives. This type of response is so widespread across human cultures that it has become known as the fundamental attribution error. It is considered an error because, when judging individuals are placed in an identical situation, they attribute their own behavior not to their disposition, but to their circumstances.[15] The result is that we tend to blame others for the accidents that befall them, rather than seek to understand the cognitive traps that fooled them (and might fool us) into making a mistake.

The bottom line of all this is that analytic decision making, a strategy most of us have grown up believing is the “rational” way to make decisions, is considerably less useful than advertised. It does work well in highly structured situations, like solving math problems, buying a new dishwasher, or planning a corporate merger. But in wilderness settings, where goals are unclear, information is complex and time is short, the analytic process is time-consuming and error-prone. For novice wilderness leaders, the advice to use analytic methods to make complex decisions is misleading at best.

We’ve seen that people avoid analytic decision making anyway – perhaps we are intuitively aware of its limitations. But if we don’t use this method, how *do* we make decisions on a daily basis?

Heuristic decision making

In a typical day, the average person faces dozens, if not hundreds of decisions. Since it’s obviously impractical for people to do a detailed and thorough analysis of each one, humans have developed shortcuts to conserve their intellectual energy.

These shortcuts, known as heuristics, work like this: when faced with a problem or decision, we look for key features in a situation and then respond based on a simple rule (figure 2). For example, imagine that you’re driving in traffic, and the car ahead of you suddenly slows. Without thinking about it, you’d probably move your foot to the brake pedal and apply the brakes. The key feature (going too fast) triggers a response (applying the brakes) that is almost automatic; you don’t evaluate all the relevant information, weigh the alternatives, and decide on the best course of action. You simply act based on a simple rule: when you want to slow down, you apply the brakes.

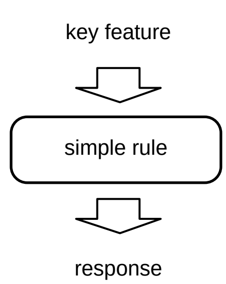


Figure 2. Heuristic decision making.

Heuristics don’t work in every instance (an icy road, for example), but they work often enough and quickly enough that in the long run, they provide an efficient balance between decision making effort and our need to have our minds free for other tasks. So it’s no surprise that in almost every area of our lives, heuristics are the decision strategy that is most frequently used.[16]

Heuristics have been studied formally since at least the 1970’s, and research has yielded a vast amount of knowledge about the heuristics people use and how those heuristics perform in laboratory settings.[17] More recently, studies of decision making under real-world conditions show that, while imperfect, heuristics serve as a powerful and versatile decision making tool.[18]

Because heuristics excel in situations where analytic methods fail (complex, unstructured environments), they are a natural choice for novice outdoor leaders. But to understand how heuristics can be best applied in wilderness settings, we need to look at how we learn them.

Where do heuristics come from?

We learn heuristics in two ways: we either discover them on our own or we learn them from others. In both cases, the environment dictates the best way to learn the appropriate heuristics.

One type of environment gives us feedback to our decisions that is immediate and proportional to the risks we take. Here, small risks have small consequences and bigger risks have bigger consequences. For example, a common progression in learning rock climbing goes from bouldering to top roping, then to following a multi-pitch climb, and then to leading. At each step, the novice gains familiarity with the simple rules that allow him to make quick decisions (Do I lieback or friction here? Do I use a figure eight or a clove hitch at the anchor?). Once decisions at one level become easier, he can move on to learning the heuristics of the next level. If he makes a mistake at any level, the heuristics he already knows (when to tie backup knots, how to fall) act as something of safety net and partially minimize his risk. But the further he goes in the progression, the more severe the consequences are for mistakes in decision making.

In these environments, where feedback to decisions is *progressive*, novices can realistically discover the appropriate heuristics on their own. Instructors and guides can provide skills training and manage some of the obvious risks, but it is up to the individual to figure out how to make accurate decisions in the situation.[19] Outdoor educators will recognize this as a common progression for teaching other wilderness skills such as sea kayaking, skiing or off-trail navigation.

Other environments, however, do not provide the luxuries of timely and proportional feedback to our decisions. Instead, feedback is *catastrophic* – it comes sporadically, seemingly randomly, and when it does it can have disastrous consequences. Examples include exposure to lightning, rock fall, and snow-covered crevasses. Apart from simulations, there are no low-risk versions of decision making in these environments; there are only accidents or close calls where disaster is averted through equipment, safe practices or chance. In these environments, we can't afford to learn the relevant heuristics on our own. We have to learn them from some one who knows the cues that indicate the hazard, and who can teach us the safe practices to mitigate the hazards when we can't avoid them.[20]

Avalanche terrain is an excellent example of a catastrophic environment. Subtle variations in terrain, snowpack and weather can produce very different hazards on neighboring slopes, making the hazard appear random to novices and unpredictable even to experts. Also, chances to practice low-consequence decision making in avalanche terrain are rare to non-existent – small test slopes don't reliably represent stability conditions on larger slopes, and even the smallest avalanches have taken lives. And once caught, even the best equipment and rescue techniques won't guarantee survival. Because of these factors, learning avalanche heuristics on your own is a risky prospect. A much better option is to learn the appropriate heuristics from a reliable source.

Accident reports are an excellent resource for deriving heuristics for catastrophic environments. Unlike heuristics developed from first principles (the physical environment alone), heuristics derived from accident accounts embody all of the complexities of humans interacting with a natural hazard. In a study of 28 years of recreational avalanche accidents (344 incidents) four heuristics emerged as being reliable cues for avoiding avalanche hazard (table 1).[21]

Heuristics for Avalanche Terrain
Avoid slopes steeper than 30° when the hazard is rated high or considerable.
Avoid terrain traps.
Avoid obvious avalanche paths.
Avoid recently wind loaded avalanche slopes.

Table 1. Preliminary heuristics for decision making in avalanche terrain. If the desired route violates any of these heuristics, the party should avoid the slope or take appropriate precautions.

It's important to note that while these heuristics can help identify when avalanche hazard is present, they cannot be used to predict avalanches or avalanche accidents. In other words, statistics tell us that when accidents have occurred, one or more of the heuristics in table 1 have been violated. What we don't know, and perhaps can never know, are how often the heuristics are violated and no accident occurs. The distinction is an important one, as we will see when we discuss heuristic traps.

To see how these heuristics work, let's consider a situation that many avalanche course graduates will surely find themselves in:

Example: Decision making in avalanche terrain

Imagine that you're a novice leader taking a group of friends powder skiing to one of your favorite backcountry areas. Your friends are all great skiers but have little or no avalanche training, and they look to you for guidance. Recent snow and wind have raised the avalanche hazard to considerable, but you haven't noticed any obvious signs of instability as you skied to a secluded slope.

As you approach the open slope from the drainage below, you see a group of four other skiers near the top, filling in a snowpit they've just dug in a large wind pillow and preparing to ski the slope. Their skin track is your quickest way to the top – it crosses low on the 32° slope then switchbacks up an open, shallow gully to the top. Your other option is to break a safer trail through the deep powder in the trees on the flank of the slope, meaning that by the time you reach the top, the other group will have made at least two runs, leaving little fresh powder for you and your friends.

As you pause to consider the situation, one of your buddies starts up the trail broken by the other group, on his way to the top. Your decision: should you follow your friend up the existing trail or should you insist that your party break its own, safer trail?

Applying table 1, the novice leader finds four heuristic violations: 1) the hazard is considerable and the slope is steeper than 30°; 2) the slope is directly above a terrain trap (the drainage); 3) since the open slope and nearby gully have no trees and prominent trim lines along their edges, they qualify as obvious avalanche paths; and 4) the wind pillow at the top of the slope is evidence of recent wind loading. To make matters worse, the existing up-track prohibits the group from exercising standard "safe practices" since the other group is above them and there are no islands of safety.[22] For this novice leader the decision is simple: the group must either break a new, safer trail or find another slope to ski.

In contrast, consider how another group leader, one motivated by a combination of accuracy, self-esteem, and conformity (discussed earlier) might structure an analytic decision. Following the stages in figure 1, he finds conflicting goals: stay safe, appear consistent with an image of being well trained, but satisfy his friends' (and his own) desire for good powder skiing. Since he lacks experience he's unable to accurately assess the importance of the wind pillow on the slope, the terrain traps around him or the avalanche paths ahead. Finally, he may too easily reject alternatives (such as breaking a time-consuming new trail) as being in conflict with the group goal of skiing powder.

In this case, the inexperienced leader is faced with a rather murky decision. Despite his training, the analytic method fails because his limited experience cannot provide him with meaningful estimates of risk. In the end, the analytic process metamorphs into a gut decision that will probably rely as much on chance as on actual knowledge.

In this scenario, the analytic decision process has a second, more sinister impact. If the group decides to follow the existing up-track across the avalanche slope, chances are quite good that an avalanche will not, in fact, occur. In this case, the group will enjoy the rewards of good skiing but will never know how close they came to an accident. In time, they may come to associate their success with spurious factors, such as their skiing ability, their route-finding skills or even their intuition.[23]

In catastrophic environments, appropriate heuristics have the advantage of re-focusing decisions on a few important cues that indicate the presence of hazard. For novices, this makes heuristics an extremely useful tool. But when the wrong heuristics are used, heuristic reasoning can be both misleading and dangerous.

Heuristic Traps

Heuristics fail when we use them in situations where they don't quite fit. In progressive-risk environments (like rock climbing), mismatched heuristics are quickly apparent because we get timely feedback showing us that they failed. We fall onto our partner's belay, the rope gets stuck, the knot slips. But in catastrophic-risk environments (like avalanche terrain), we can get away with using mismatched heuristics, sometimes for years, before we get feedback that our heuristics have failed. The feedback, when and if it comes, is so abrupt that we rarely get the chance to understand how or why our heuristics failed. This trap is especially dangerous when it involves heuristics that we take for granted: those that operate at the threshold of conscious thought.

Psychologists have identified a number of heuristics that we use so often, and in so many situations, that they have become unconscious reflexes in much of our day-to-day decision making. In study after study, researchers have found that these heuristics guide our behavior to a far greater degree than most of us recognize, and their repeated and pervasive success in advertising campaigns, sales promotions, and political propaganda is eloquent testimony not only to their existence, but to how effectively they can be used to influence our beliefs and behavior.[24] Six of the most common unconscious heuristics of influence are listed in Table 2.

Name	Trigger feature	Heuristic
Familiarity	familiar setting or situation	If I've done it before then it's what I should do now.
Authority	credible expert opinion	If an expert believes it then it's what I should believe.
Social proof	behavior of people similar to myself	If people like me are doing it then it's what I should do.
Commitment/ consistency	opportunity to validate prior actions or words	I should remain consistent with my prior opinions and actions
Liking/ conformity	actions by a person or group that I like	If someone I like is doing it then it's what I should do to be accepted.
Scarcity	competition for a limited resource	If something is scarce then I should desire it.

Table 2. Common heuristics in unconscious decision making [adapted from Cialdini (1999) and Zimbardo and Leippe (1991)].

To see how these unconscious heuristics work against us in catastrophic environments, let's reconsider the avalanche terrain example from the perspective of a leader who is influenced by these six heuristics. His unconscious dialogue might go something like this:

"The slope is familiar and nothing has ever happened here before (familiarity). The other group of skiers dug a snowpit (suggesting expertise) and decided to ski the slope (authority and social proof). As a leader, I've brought the group this far without incident (commitment) and giving my friends a chance to ski this slope would make me appear to be a strong leader (consistency). My friends want to use the existing track and ski the slope (liking and conformity). If we break our own trail, we'll miss out on the good skiing (scarcity)."

It's easy to see how, with little conscious thought, this leader could make a quick decision to follow the existing up-track across the avalanche slope, directly beneath the other party of skiers. As we've seen, chances are good that he and his party will make it without incident. But the outcome, if it teaches him anything, will suggest that his decision process was correct, and lead him to rely on these heuristics even more the next time he faces a similar situation.

But if this leader's heuristics have worked once, is there a problem with using them every time?

A problem exists because his decision

criteria are based on factors largely unrelated to the actual avalanche hazard. Four of his heuristics (social proof, commitment, liking, and scarcity) are based on social circumstances. And accident data shows that the familiarity heuristic is a poor predictor of avalanche hazard. Even the authority heuristic here is questionable, since the snowpit they dug in a wind pillow (which yields misleading results) suggests that other skiers were not, in fact, experts in avalanche assessment. In the end, this leader's heuristic habits stand in the way of his learning to make fact-based decisions in avalanche terrain. In reality, his training becomes little more than a rhetorical tool to rationalize decisions based on his unconscious heuristics.

So how does a novice leader combat the lure of unconscious heuristics? Research suggests that simply knowing the conditions (trigger features) under which a heuristic trap can occur is not enough.[25] Likewise, building arguments why you are not falling into a heuristic trap during any particular decision are more likely to be exercises in analytic slight-of-hand than an actual deterrent.[26] The most effective means appears to be testing the trigger features of these heuristics against the actual conditions (does another group's tracks have any bearing on the actual avalanche hazard?). If the test shows no meaningful relationship then the novice leader must use other, more appropriate heuristics (such as those in table 1) or choose a particularly conservative course of action.[27]

So, if a novice is armed with heuristics that are appropriate to the situation and has a solid understanding of how to avoid heuristic traps, will he always be able to make the correct decision? The answer depends on his ability to perceive the exceptions to the heuristics – a skill that comes with expertise.

Expertise

For years, cognitive psychologists assumed that experts used some combination of heuristics and analytic decision making when they made choices in their domain of expertise. In their view, expertise was essentially an efficient search through a large database of acquired knowledge. They believed that experts faced with a decision would evaluate the situation, quickly but methodically sort through their vast memories of similar experiences, and select or devise an alternative that worked.[28]

But in the 1980's, two notable failures – the failure of cognitive psychology to predict expert response using classical theory and the failure of artificial intelligence to build machines that duplicated experts' decisions – prompted a fundamental re-assessment of how experts make decisions.

Scientific controversy still surrounds explanations of expert decision making,[29] but one thing has become clear: experts routinely make fast *and* accurate decisions without resorting to classical decision methods such as heuristics or analysis.

Gary Klein, a leading researcher in the field of expertise psychology, has proposed a model of expert decision making that is based on the idea that expertise and intuition arise from the way experts categorize their memories. Klein's model, called the recognition-primed decision (RPD) strategy, is shown in figure 3. Here's how the model works:

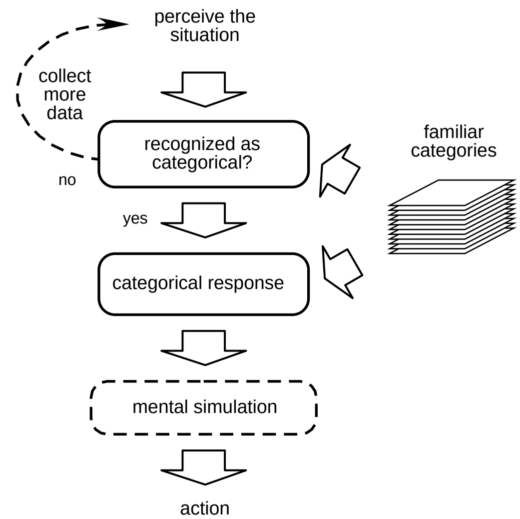


Figure 3. Recognition-primed decision making model of expertise (after Klein, 1998).

When faced with a problem in their domain of expertise, experts will recognize a situation as typical of a category of situations, with familiar features and circumstances. In contrast to heuristic methods, which rely only on recognizing key situational features, RPD expertise relies on the expert being able to recognize *patterns* of key features. Typically, the expert is unaware of the exact pattern that triggers her response; she just "knows it when she sees it." Detailed investigation into how experts see the world reveals that they have a sometimes uncanny ability to recognize subtle patterns of cues and, importantly, situations where those cues are absent or conflicting.[30]

Studies by Klein and others have demonstrated that the RPD model closely fits observations of expert decision making in areas ranging from chess playing and computer programming to fire fighting and warfare command. But because the model is still relatively new, it has yet to be validated by experiment and remains a promising theory awaiting rigorous confirmation.[31]

Despite its status as an emerging theory of expert decision making, the RPD model is nevertheless useful for understanding how an experienced outdoor leader might face a difficult decision, and the traps that await a leader who lacks sufficient experience.

Example: Ascent of Spider Peak

Imagine that you're leading two students on a technical climb in the Wind River Mountains of Wyoming. Your party got an early start, planning to summit by 11 o'clock and be off the exposed peak by 1 PM to avoid the daily afternoon thunderstorms. Up to this point of the course, the two students have been strong climbers. But for some reason, today they are managing the belays poorly and are growing less attentive to safety as your climb has progressed.

Climbing one at a time, you've averaged less than one pitch an hour. It's now 11 o'clock and you have two more pitches to go, and it's clear from the building clouds and distant thunder that the afternoon storms will be coming earlier today, perhaps as early as noon. Below you lie the five pitches you've already climbed; a winding route with many traverses to avoid areas of loose rock.

To avoid getting caught on the summit in a lightning storm, you face a difficult decision – do you rappel the route, crossing the hazardous sections of loose rock while the storm moves in, or do you continue climbing and try to be off the summit by the time the storm hits? Waiting out the storm on the exposed face is not a practical option.

This example incorporates all of the circumstances where expertise excels: the situation is complex, goals are conflicting (safety versus speed), there are high-stakes consequences, and the decision must be made quickly. Of course, different experts will handle this situation differently depending on their skills and experience, but here is how Scott, a seasoned co-instructor, handled this situation on one of my first courses:

As soon as both students arrived at the belay, Scott explained that he was going to lead the last two pitches as usual but instead of belaying each student separately, he would belay them on separate ropes. They would follow each pitch simultaneously. He stressed the importance of moving fast and safely despite the unfamiliar belay arrangement. He got verbal agreements from each of the students to remain focused and efficient, and then he led off. Despite some difficulty disassembling the anchors, the students moved quickly and they were able to summit in good time. By the time the lightning storm began in earnest, they were already on the lower slopes of the peak, on their way back to camp.

Watching their progress from camp, I had seen their painfully slow pace on the lower part of climb; it had seemed inevitable to me that, unless they turned back, they would be caught on the summit in the heart of the earlier-than-usual storm. Later, while debriefing his climb over dinner, I was struck by the clarity and ease of Scott's decision. That he had quickly assessed the route and its hazards and used an old guide's trick to speed their way to the summit was a testament to his mountaineering skills. But what impressed me was his ability to accurately asses the as-yet unproven potential of these two students to adapt to an unfamiliar belay system and to move quickly over terrain that had impeded them all morning. When I asked Scott why he was so sure that the two students would rise to the situation, he said: "I don't know how I knew. It just felt right at the time."

Years later, while researching expert decision making, I found that such statements are common when people face difficult decisions in familiar circumstances. Apparently, over time, experts unconsciously categorize situations by the response most likely to produce the desired result. In the example, Scott was under time pressure on a route with two students he believed could perform at a higher standard. He recognized this as the kind of situation where being directive and requiring the students to rise to their potential would allow them to move quickly and be off the summit in time to avoid the lightning hazard. Obviously, success lay in being able to accurately assess the students' likely response; an assessment that could be made only with considerable experience over many years and with many different students. In the end, Scott's decision succeeded in getting his party off the peak safely and provided a powerful leadership role model to the students.[32]

Expertise Traps

Whether we are aware of it or not, all of us have expertise in hundreds of areas. Mostly, we use our expertise in mundane tasks such as conversation, reading handwritten notes, driving to work, dealing with our families, or shopping. All of these situations have at least two things in common: we have experienced them thousands of times, and our intuition is usually right.

In unfamiliar situations, people prefer to use heuristics, as we have seen. But our expertise is such a powerful tool in familiar circumstances that, when we lack reliable heuristics in an unfamiliar situation, we are tempted to use our expertise anyway. This temptation, to make an expert-like decision in a situation where we lack expertise, is the expertise trap.

I've noticed this trap most often in students during decisions involving off-trail navigation, river crossings and avalanche terrain. Typically, a novice leader faced with a decision will attempt to summarize the relevant information, and make a "seat of the pants" decision. Usually, unless there is dissent in the group, the decision goes unchallenged and the outcome is reasonably safe. But in some cases, such as crossing a suspect avalanche slope with no expertise of the snowpack or terrain, the outcome of unfounded intuition can be disastrous. As we saw with heuristics, catastrophic environments are poor places to learn through trial-and-error.

Klein proposes two ways to avoid expertise traps, both of which are quite simple. The first is the experience test, where intuitive decisions are challenged by group members with the question "What experience are you basing that decision on?" A wilderness leader that bases an intuitive decision about a difficult river crossing on twelve years' experience crossing rivers will have a far easier time convincing her students to follow her than will a leader who has crossed rivers only once or twice.

A second way to avoid expertise traps is what Klein calls the *pre mortem* test. In this test, the group imagines that the leader's intuitive-based decision has been executed flawlessly, but failed. A quick survey of people's ideas of why the plan went wrong will usually reveal any prominent errors in reasoning or expertise. The great advantage of this test is that, instead of inviting criticism of a plan (which can generate defensiveness), it invites creative simulation of possible outcomes. In reaching a sound decision, the groups also gains experience performing a "what if" scenario – a valuable step in developing expertise.

Teaching Better Decision Making

Strictly speaking, it's probably not possible to teach people how to make decisions because they already do it pretty well. Much of the decision making literature of the past implied that there was some "right way" to make decisions – a way that was free of biases and errors. This is almost certainly a myth, and the idea that human beings can consistently make optimal decisions using some secret technique is entirely unsupported by experimental evidence.[33] Learning to make *better* decisions, however, is a different matter, one that can be addressed by applying current knowledge of how people learn.

Figure 4 shows a generalized representation of the decision strategies presented in this paper. We've seen that appropriate heuristics work well for the novice, and that analysis is an effortful and potentially error-

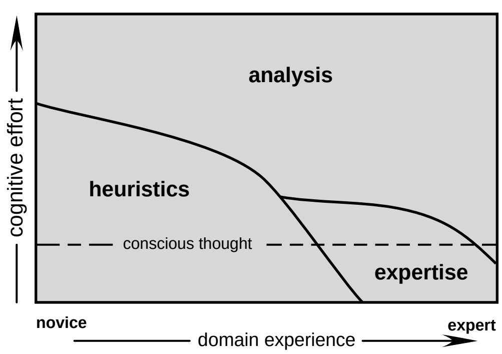


Figure 4. Generalized regimes of three decision strategies. The graph is a composite of the research findings cited in the text.

prone bridge between heuristics and expertise. We've also seen that expertise, once developed, is a powerful tool for making decisions in the complex, high-stakes world of the wilderness leader. Research suggests several ways to facilitate the progression from novice to expert in any given decision domain:

Help people recognize which decision strategies they use, and the circumstances under which those strategies might fail – In this paper, I've tried to present a balanced overview of the different decision processes being discussed in the current literature. There are some things each process does well, some things each process doesn't do so well, and much that remains unexplained. Hopefully, others will find the framework I've described helpful as they teach their students to make decisions. It's clear that the importance of direct experience cannot be emphasized enough. Thoughtful analysis and robust heuristics can help novices make decisions in the wilderness, but they are no substitute for actual experience.

Facilitate the learning of heuristics and the recognition of heuristic traps – We've seen that heuristics can be a powerful decision making tool for novices, and that robust heuristics can be derived from accident statistics. If you are developing heuristics for a particular domain, here are some characteristics that will make them more effective and easier for your students to use:[34] 1) they should favor easily recognized or easily learned trigger features, 2) they should connect those trigger features with action, 3) they should be logically positive (e.g. "avoid terrain traps" rather than "avoid areas that are not safe"), and 4) they shouldn't restrict the activity they are meant to facilitate (e.g. "avoid obvious avalanche paths" rather than "avoid all potential avalanche slopes"). Heuristics are relatively simple to learn through conventional behavioral methods.[35] Heuristic traps, as we have seen, can be avoided by testing the trigger features of unconscious heuristics (familiarity, authority, social proof, commitment, liking, and scarcity) against the nature of the hazard.

Facilitate the learning of analytic decision methods and the recognition of rationalization traps – While analytic decision methods have a number of shortcomings in wilderness situations, they are relatively easy to teach using a simplified behavioral strategy, where students are shown the process and allowed to practice.[36] Unfortunately, problems solvable by novices must either be highly simplified or augmented with experience-based data. As always, timely and accurate feedback will accelerate learning.

Facilitate the development of expertise and the recognition of expertise traps – To help students develop expertise once they have mastered heuristic decision making, research suggests using activities that help them organize their existing knowledge into categories, and to see common patterns in each category. Teaching strategies include: traditional cognitive teaching methods, focused simulations and examples, student documentation of decisions and situational patterns, and structured storytelling.[37]

Table 3 summarizes the decision strategies discussed in this paper, along with their associated traps, errors and

Strategy	What it is	Errors and traps	Teaching methods
Heuristics	simple rules	mismatch error exception error unconscious heuristic trap	• define target skills • present well-defined heuristics • demonstrate their use • student practice with feedback
Analysis	step-by-step logical process	certainty error capacity error motivation error dissonance traps attribution traps	• demonstrate the process • let students practice • simplified problems are best
Expertise	intuition based on experience and knowledge	exception error expertise mismatch trap	• categorization exercises • focused simulation • decision documentation • reflective storytelling

Table 3. Decision strategies, traps and teaching methods.

teaching methods. While I've attempted to provide a snapshot of three major schools of modern decision science, the results presented here should in no way be considered definitive or complete. Decision science is like many other fields today, dynamic and complex, with new research results emerging constantly. But in one respect decision science is unique: it not only gives us a glimpse into how we make sense of the unknown, it is itself a manifestation of how we make decisions and learn from our experiences.

You've probably already noticed that the three decision strategies listed in table 3 are nothing more than heuristics themselves; models created so that we can make sense of the complexity of human decision making. That we embrace such heuristics is a clear indicator of where we stand in our knowledge of our own decision making – we are still only at the novice stage. Someday, perhaps, we will develop the expertise to see deeply into our own decision processes and detect familiar patterns (and the exceptions to those patterns), and understand what those patterns mean. Perhaps then we will be truly able to appreciate the remarkable ability of our species to make decisions not only amidst the complexity of our world, but amidst the complexity within ourselves.

Notes

1 This paper is an extension of a preliminary study exploring why avalanche accidents happen to people who have been trained to avoid them. More details can be found in McCammon (2000). While my work so far has focused on decision making by individuals; I hope in future work to look at the important area of decision making by groups.

2 For reviews of classical decision theory and its applications, see Plous (1993) pp. 77-105, Crozier and Ranyard (1997) pp. 5-20, and Byrnes (1998) pp. 7-25.

3 See, for example, Harvey (1999) p. 43, or the NOLS Wilderness Educator's Notebook (1999) p. 3–12.

4 For general applications of analytic strategies, see Lewis (1997), Russo and Schoemaker (1989), or Johnson (1992). For a discussion of how to apply analytical methods to wilderness settings, see Graham (1997) pp. 53–65.

5 Simon (1990a), Damasio (1994) pp. 46–51.

6 See Beach and Lipshitz (1993) or Klein (1998) for reviews.

7 See Cialdini (2001) or Pratkanis and Aronson (2001) for examples.

8 See Miller (1954) and Landauer (1986).

9 See Chen and Chaiken (1999) for a discussion of these factors in a social psychology context.

10 See McCammon (1999) for a discussion of how these factors affect wilderness leaders, and Lencioni (1998) for the role these factors play in business decisions.

11 Means, et al. (1993).

12 Smoking, unprotected sex, buying a home in a hazardous area, illegal drug use and many other logically puzzling human behaviors have been demonstrated to be influenced by cognitive dissonance effects. See Pratkanis and Aronson (2001) pp. 40 – 47, Plous (1993) pp. 22–30, and Aronson (1995) for further examples and explanation.

13 Klein, pp. 10–12 and Means et al. (1993).

14 Dörner (1996), pp. 177–183, describes this as "ballistic behavior" and notes its absence when feedback to our decisions (perhaps from an experienced course leader) is more frequent.

15 See Plous (1994) pp. 180–188 for a discussion.

16 Bodenhausen et al. (1999); Gigerenzer et al. (1999)

17 Since most experiments in decision making have been designed to explore how heuristics fail, heuristic reasoning has, until recently, been viewed as heavily flawed and biased (see, for example, Tversky and Kahneman, 1986, 1974 or Slovic et al. 1982). Clement (2000) explores the

ramifications of this research for outdoor leaders.

[18] See, for example, Chaiken and Trope (1999) or Gigerenzer et al. (1999).

[19] Hertwig (1999) and Dörner (1996) pp. 98–105.

[20] Gookin (2000), for example, presents heuristics for recognizing conditions that lead up to lightning hazard and what to do if you can't avoid it.

[21] Specific heuristics for travel in avalanche terrain, developed from accident data, are presented in McCammon (2002).

[22] "Safe practices" for avalanche terrain are: 1) carry rescue equipment; 2) have a plan using islands of safety; 3) expose only one person at a time; 4) maintain contact with the person exposed; and 5) don't travel alone. See, for example, Fredston and Fesler (1994) pp. 91–100.

[23] Psychologists who study gambling call this effect "selective hypothesis testing" because it considers only positive outcomes (no accident) and overestimates the contribution of minor factors. See, for example, Gibson et al. (1997).

[24] See Cialdini (2001), Pratkanis and Aronson (2001) or Zimbardo and Leippe (1991) for further discussion.

[25] Cialdini and Petty (1981).

[26] Petty and Cacioppo (1979).

[27] See Pratkanis and Aronson (2001) pp. 329–356 for a discussion.

[28] See Chi et al. (1988) pp. xv–xxxvi and Kirlik et al. (1997), and Klein (1998) for reviews of classical interpretations of expertise.

[29] See Flin, R. et al. (1997) for a fine survey of current controversies in expert decision making.

[30] See Klein (1998) pp. 15–30. Erickson (2000) reviews Klein's work in the context of risk management and accident analysis.

[31] To be considered valid, a scientific theory must not only explain observed events, but it must also reliably predict future events under controlled conditions. While critics of expertise theory have rightly pointed out the difficulties of predicting expert decisions in real-world settings (Flin et al., 1997, pp. 1–8), validation of expertise models can also be accomplished indirectly, such as by predicting systematic errors and biases, as has been done with heuristic reasoning.

[32] Just as important to expert judgement is recognizing when a situation *doesn't* fit a familiar pattern. Spotting these exceptions is one of the key differentiating factors between the outcome of expert versus heuristic decisions.

[33] Some argue that the "magic bullet" theory of solving problems arises from the simplified way we learn critical thinking as children, or the permeation of "magic bullet" messages in advertising (Berk and Berk, 1993, pp. 162–171, Pratkanis and Aronson, 1999, pp. 21–47). As we know from our own real-world decisions, most problems have complex causes and no single solution (Simon, 1990b).

[34] These qualities are adapted from various studies on effective learning. See Goldstein and Gigerenzer (1999), Jensen (1998) pp. 82–89, Penner and Klahr (1996), Davis and Davis (1998) pp. 118–124.

[35] Davis and Davis (1998) pp. 103–135 or Anderson (1993).

[36] Nickerson (1994).

[37] Davis and Davis (1998) pp. 137–174, Means et al. (1993) and Klein (1998).

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