Journal of Outdoor Recreation, Education, and Leadership 2016, Vol. 8, No. 2, pp. 119–135
https://doi.org/10.18666/JOREL-2016-V8-I2-7697

The Dialectical Utility of Heuristic Processing in Outdoor Adventure Education

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Abstract

Heuristics—cognitive shortcuts used in decision-making events—have been paradoxically praised for their contribution to decision-making efficiency and prosecuted for their contribution to decision-making error (Gigerenzer & Gaissmaier, 2011; Gigerenzer, Todd, & ABC Research Group, 1999; Kahneman, 2011; Kahneman, Slovic, & Tversky, 1982). Recent research in outdoor adventure education (OAE) using the heuristic concept to diagnose field-based decision-making errors has ignored this duality, focusing solely on the negative potential of heuristic processing (e.g., Clement, 1997; McCammon, 2004a; Simenhois & Savage, 2009; Tremper, 2008; Wheeler, 2008) and neglecting positive and prudent uses of heuristic processing in field-based risk management. This conceptual manuscript follows the suggestion of Furman, Shooter, and Schumann (2010) to explore the dual-nature of heuristic processing in OAE. Using a dialectical method, the authors interrogate the dominant, negativistic interpretation of heuristic processing as well as illustrate the common uses of heuristics in risk management curricula within outdoor pursuits. In the resulting synthesis, the authors show that a *symptom-prescription* view of heuristic duality can reclaim the utility of heuristics as decision-making aids (e.g., scenarios, mnemonics, visual models) in OAE, as well as provide implications for decision-making scholarship and field-based practice.

KEYWORDS: heuristic processing; decision making; risk management; avalanche terrain; outdoor adventure education

Acknowledgments. The authors acknowledge and thank Dr. Jasper S. Hunt for his support and mentorship in the preliminary stages of conceptualization and writing.

Outdoor pursuits are inherently risky. Equipment failure, wildlife encounters, and extreme weather events are potential risks that outdoor educators and their students regularly encounter as they step outside (Haegeli & Pröbstl-Haider, 2016; Hronek & Spengler, 2002). Although these risks are routinely navigated by outdoor educators, the cognitive processes underpinning the navigation—*judgment and decision making*—also carry a certain level of risk (Galloway, 2005; Priest & Gass, 2005; Shooter & Furman, 2011). Discerning if a storm cell will pass or persist, whether acute abdominal pain will require evacuation, and whether recent heavy rains will render a river unrunnable all warrant prudent, systematic, and deliberative judgment and decision making. However, in spite of increased attention to risk management information and training (Ball, 2012; Johnson, Haegeli, Hendrikx, & Savage, 2016; Powell, 2007; Rousseau, 2011), even seasoned outdoor educators occasionally fail to make the right choices; instead, they rely on partial information, biases, mental models, and decision-making traps, with potentially disastrous results (Branch, 2012; Fredston, Fessler, & Tremper, 1994; McCammon, 2004b; Simenhois & Savage, 2009).

In an effort to reduce human factor accidents and incidents in outdoor pursuits, the field of outdoor adventure education (OAE) has recently turned to judgment and decision-making science (JDM). Specifically, one JDM construct, *heuristic processing,* has received considerable attention in OAE (e.g., Clement, 1997; Furman, Shooter, & Schumann, 2010; Leemon & Schimelpfenig, 2005; Madden, 2010; McCammon, 2000, 2004a; McCammon & Haegeli, 2007; Page, 2014; Richardson, 2011; Tremper, 2008; Walker & Latosuo, 2016). Heuristic processing refers to the use of experience-based cognitive shortcuts that overlook part of the information within a decision-making event (Gigerenzer & Gaissmaier, 2011). Heuristic processing scholarship was pioneered through the *heuristics-and-biases* program of Nobel Laureate Daniel Kahneman and his long-time colleague Amos Tversky. Unlike rational, deliberative decision-making models that weigh potential options and probabilities (e.g., decision-making trees, stepwise models), heuristic processing, Kahneman and Tversky argue, reduces the complexity in decision making by focusing on "fast and frugal" rules and shortcuts (Gigerenzer, Hoffrage, & Goldstein, 2008; Kahneman, 2011; Tversky & Kahneman, 1974). For example, unconsciously turning *right on red* when driving a car in the United States or habitually looking both ways before crossing a street are relatively simple heuristics many of us employ daily.

Despite the potential efficiency these simple heuristics provide, a reliance on cognitive shortcuts may also contribute to decision-making error. Over 4 decades of JDM laboratory research have demonstrated that heuristics may, at times, serve as biases or traps that discount vital information and lead to less-than-optimal decisions (e.g., Evans & Over, 2009; Gilovich, Griffin, & Kahneman, 2002; Kahneman, 2011; Kahneman et al., 1982). For example, subjects in the initial heuristics-and-biases experiments inaccurately assigned individuals to specific professions based on gender and political stereotypes or inflated the likelihood of natural disasters based on disaster salience (Kahneman, 2011). In various studies, subjects followed a reliance on experienced-based, often unconscious rules of thumb—heuristics—to reduce cognitive effort in the decision-making process. Although these heuristic decision-making errors in laboratory experiments pose minimal risk to subjects, when the same cognitive processes are applied outside the laboratory, particularly in volatile field-based settings, the results can be problematic, if not life-threatening.

Empirical research employing the heuristic concept in OAE is a relatively recent trend; however, the idea that outdoor educators and their students use shortcuts and biases to make decisions is foundational to the decision-making scholarship of OAE (Clement, 1997; Condon, 2013; Ewert, 1994; Priest & Gass, 2005). "Summit fever"—the continued pursuit of a mountain summit despite information indicating that the pursuit is likely unsafe (e.g., looming thunderclouds)—is perhaps the most classic parable of poor judgment in OAE (Atkins, 2000; Leemon & Schimelpfenig, 2005). Summit fever is also undeniably heuristic: The outdoor educator focuses on a specific goal (summiting) rather than deliberating and considering conflicting information (thunderclouds). Although similar examples of heuristic processing exist in decision-making literature across outdoor pursuits, the wealth of recent scholarship in avalanche education is perhaps the most comprehensive and compelling (e.g., Fredston et al., 1994; Gehring & Latosuo, 2014; McCammon, 2000, 2009; Simenhois & Savage, 2009; Steenburgh, 2014; Tremper, 2008). For those responding to the rising number of incidents and accidents in avalanche terrain (e.g., Colorado Avalanche Information Center, 2014), heuristic processing has become a primary lens for decision-making research and practitioner education to guard against decision-making error (Grímsdóttir & McClung, 2006; McCammon & Haegeli, 2007; Page, 2014; Wheeler, 2008).

Within this surge of heuristic processing research in avalanche education lies a curious paradox: Many heuristics are categorically rejected as bad decision-making aids for avalanche terrain, but other heuristics are regularly employed in avalanche education praxis (Furman et al., 2010; McCammon, 2004a; McCammon & Haegeli, 2007; Powder Magazine, 2014). For example, McCammon's (2004a) a posteriori coding of heuristic traps within human-triggered avalanche accidents has shown that heuristic use can lead to dramatic, sometimes fatal results; unwavering commitment to goals and objectives (e.g., summit fever) and reliance on the opinions of perceived experts have both been shown complicit in avalanche accidents and fatalities (Bader, Bostock, Lau, Quade, & Wilkes, 2010; Branch, 2012; McCammon, 2004a). Conversely, it is increasingly evident that avalanche educators and OAE professionals regularly employ heuristics as foundational mnemonics, parables, and problem-solving strategies to manage risk (e.g., Leemon & Schimelpfenig, 2005; Madden, 2011; McCammon, 2006; McCammon & Haegeli, 2007). For example, digging a snowpit on a "representative" slope to assess snowpack conditions is one of the most basic decision-making tenets of avalanche education, as well as an example of one of Kahneman and Tversky's foundational heuristics: "representativeness" (Tversky & Kahneman, 1974; Zajchowski, 2011a). This presence of helpful and harmful heuristics within avalanche education and the resulting paradox leads us to question the nature of heuristic processing in outdoor pursuits. More to the point, given their mercurial potential, to what degree should outdoor adventure educators embrace or avoid heuristic techniques to reduce risk? And, if heuristics serve some benefit in OAE decision making and risk management, what tools assist outdoor adventure educators to know when to use, embrace, avoid, or discard certain heuristics?

In the following pages, we begin to answer these questions using a dialectical method (e.g., Adler, 1927; Dare, Welton, & Coe, 1987; Plato, 1992) to pursue a thorough investigation of the fundamental nature of heuristic processing in OAE. With its roots in Ancient Greece, the dialectical method seeks truth through reasoned arguments from opposing viewpoints. Socrates, one of the most well-known practitioners of dialectics, would question his students, deconstructing and refuting their perceptions of truth—their *theses*—about the issue at hand. Socrates' negativistic dialectic (see Stone, 1989) was later refined by Hegel (e.g., Fagerström & Bergbom, 2010; Plant, 1997), whose dialectic permits an *antithesis* to further interrogate opposing propositions and theories. In what is often referred to as Hegelian dialectic, the resulting *synthesis* of information gleaned from interrogating the *thesis* and *antithesis* would advance knowledge about a subject. More recently, OAE, experiential education, and nature-based tourism scholars have employed dialectics to explore and inform the roles of place, race, and curricula in diverse settings and contexts (Brookes, 2002; Harrison, 2010; Rose & Paisely, 2012; Weber, 2001).

In this conceptual manuscript, a dialectical method will be employed to augment our knowledge regarding the nature of heuristic processing in OAE. Given the wealth of empirical scholarship focused on the negative outcomes associated with heuristic processing in outdoor pursuits, we first question the *thesis* that heuristics are generally bad for outdoor adventure educators and their students. To do so, we investigate the origins of the heuristic concept, as well as its operationalization and practical applications across diverse fields. Using this information, we then offer an *antithesis*, focusing on the codified manifestations of heuristic processing within OAE. We interrogate the antithesis—that heuristic processing is both good and bad for OAE—through comparing the respective utility of two heuristic devices used in avalanche education.

The resulting *synthesis* reveals that a new frame may assist in designing and using helpful heuristic tools to confront harmful heuristic traps. In sum, we use this dialectic to illustrate the complexity of heuristic ontology, suggest new avenues for inquiry, and highlight the potential value of the heuristic concept in OAE.

Thesis

Our first task in this dialectical method is to deconstruct the thesis that heuristic processing is inherently bad for outdoor adventure educators, by exploring the fundamental nature—*ontology*—of heuristics. Exploring the nature of heuristic processing is crucial to our inquiry, as it will allow us to better understand the composition of heuristics and discover the utility of heuristic processing outside of OAE. We then apply this information to OAE, refine our understanding of heuristic processing, and subsequently question the initial thesis that heuristic processing is solely harmful for OAE professionals and their students.

Heuristic Ontology

Many outdoor adventure educators unfamiliar with the heuristic semantic likely recognize its synonyms, such as human factors, mental models, or decision-making traps. Classic examples of heuristic processing parables within OAE include (a) proceeding to a group-belayed high element in challenge course programming despite lack of group cohesion and trust, because of a propensity to remain consistent with stated goals, or (b) paddling a stretch of whitewater despite recent heavy rains, because of familiarity with the river at lower water levels. In each case, the OAE professional potentially discounts situational information—lack of group cohesion and trust or recent heavy rains—in favor of heuristic strategies, such as *consistency*, *familiarity*, or *affect* (see McCammon, 2004a). In this case, reliance on heuristics may jeopardize overall goals (e.g., team building, river navigation) and threaten personal and group safety. This interpretation of heuristic processing is understandably negative.

Outside the perils of the backcountry, however, scholars have defined heuristics with greater ontological neutrality. "Heuristic" originates from the Greek *eureka,* describing a search or discovery ("Artificial Intelligence," 1999). Accordingly, researchers from a diverse cadre of academic and professional practices—such as economics, law, medicine, and philosophy—have employed the heuristic concept as a tool in the search for knowledge (Green & Mehr, 1997; Kahneman, 2011; Romanycia & Pelletier, 1985; Sustein, 2002). Heuristics underpin "the sensibly guided search" in the pursuit of wisdom, *phronesis*, for the Ancient Greeks ("Artificial Intelligence," 1999). They have been used to explain the behavioral biology of animals (Hutchinson & Gigerenzer, 2005), variability in climate change beliefs (Brownlee, Powell, & Hallo, 2013), and the next wave of inquiry within artificial intelligence (Russell & Norvig, 2009). Scholars in rhetoric, philosophy, and experiential education refer to heuristics as models or analogies that describe phenomena and advance knowledge and understanding (Barrachi, 2002; Mullins, 2014). In sum, experience-based rules, analogies, models, and shortcuts, in general, are heralded for their ability to provide comprehension and decision-making efficiency in various situations—from knowing when to cross the street to sentencing in the criminal justice system (von Helversen & Rieskamp, 2009).

Regardless of these diverse interpretations and applications, what makes heuristics unique from systematic and deliberative decision-making models is a reliance on intuition, affect, situational cues, as well as discounting additional information to catalyze action (Gigerenzer & Gaissmaier, 2011). This process of systematically selecting and pruning information is likely 'hardwired'—evolutionarily born from the necessity to conserve cognitive capacity for processing thousands of daily decisions. Einhorn (1980) contended that heuristic processing allowed early hominids to determine quickly and efficiently which actions were favorable to their well-being and survival, which ultimately contributed to the survival of our species. Cognitive shortcuts were beneficial when dealing with many situations, from predators on the ancestral plains to rapidly changing weather conditions (Gardner & Stern, 2002; Kahneman, 2011). Subsequently, humans operating in 21st century streets and mountain summits have, for better or worse, inherited heuristic processing as one of the tools in their decision-making toolbox.

In recent years, heuristic processing has been predominantly investigated for its infamous Achilles' heel: the ability to lead us astray. Specifically, reliance on cues and *cognitive pruning* (Brown, 1972) contributes to higher efficacy in various contexts (DeMiguel, Garlappi, & Uppal, 2009; Wubben & v. Wangenheim, 2008), but when applied to scenarios in which risk perception is crucial, heuristics can produce negative and fatal results (McCammon, 2004b). In these comparisons, based on probabilistic models that assume a "correct" decision, heuristic processing often represents an end of a continuum of decision-making strategies. Scholars often refer to heuristic-based decisions as *System 1* cognitive strategies, described as automated, intuitive, automatic, affective, effortless, unconscious, and/or preconscious. On the opposite end of the continuum, *System 2* decision-making processes are often described as controlled, rational, analytic, rule based, systematic, effortful, logical, and/or deliberative (Kahneman, 2011). For example, each end of the decision-making continuum can be compared to lead characters from the movies and television series *Star Trek*: Captain Kirk generally represents heuristic processing (System 1) and Spock represents deliberative processing (System 2). As we will show in OAE, many scholars have enumerated the disadvantages of Captain Kirk's fast and frugal techniques, naming them biases or traps, largely without examining the advantages.

Heuristic Use in OAE

This same tension exists in the application of the heuristic concept to OAE: Heuristics are associated with negative traps and pitfalls (e.g., McCammon, 2004b) but also codified as common decision-making aids (Table 1). Mnemonics and acronyms such as SERENE (Strong, Equalized, Redundant, Efficient, No Extension) for anchor building or RICE (Rest, Ice, Compression, Elevation) for backcountry treatment of musculoskeletal injuries are standard heuristic devices for rock climbers and wilderness medicine practitioners, respectively (Leemon & Schimelpfenig, 2005). The foundation of Leave No Trace (LNT) is a set of enduring principles that are fundamentally cognitive shortcuts intended to simplify incredibly complex interactions between human behavior, time, and ecosystem functions, as well as between preferred ecological and social outcomes. Parables, such as those printed in the American Alpine Club's (2014) annual publication of *Accidents in North American Mountaineering,* serve as practical narratives that provide examples from the mistakes, accidents, and experiences of others. For instance, *Accidents* provides stories about a climber who lost a finger pulling on a bolt or an alpine climber struck by lightning, with the intent that other climbers learn from these examples of poor decision-making in order to not suffer the same fate. Simulations and scenarios, popular within a diverse set of technical skill development curricula (e.g., wilderness medicine, swift water rescue, avalanche education), serve to prime students to recognize specific cues and respond quickly, efficiently, in a manner appropriate to context (Priest & Gass, 2005).

Table 1
Sample Heuristic Devices Used in Outdoor Adventure Education

Heuristic device	Examples
Mnemonics	Example #1: Acronyms such as SERENE help evaluate rock climbing anchors
	Example #2: Rhymes such as "Reach, Row, Throw, Go" describe the process of assisting someone who fell out of a boat
	Example #3: Mnemonics such as "Pass The Donut Left My Rotund Brother" (in which the first letter of each word represents an LNT principle) assist LNT students to recall LNT principles
Parables	Example #1: In consideration of Pete Absolon's death in the Wind River Range, climbers now have a better understanding not to throw rocks off of cliffs (Prendergast, 2007; Zajchowski, 2007)
	Example #2: In consideration of Krakauer's *Into Thin Air*, mountaineers now better understand the importance of sticking to a turnaround time when engaging in high-altitude mountaineering (Krakauer, 1997)
Simulations and Scenarios	Example #1: Rehearsing ABCDE (airway/breathing/circulation/decision/environment) in a WFR class—repetition of this foundational order of operations allows students to respond to medical scenarios without engaging complex decision-making processes
	Example #2: Rehearsing avalanche beacon rescue allows for practitioners to focus on the most relevant cues (e.g., beacons, gloved hand sticking out of the snow)
Visual Models	Example #1: The Utah Avalanche Center compass rose (see Figure 1)
	Example #2: Snowpit profiles take a highly complex structure and graphically represent the strata of hard and weak layers to determine quickly if there are structural instabilities

In addition to these codified heuristic strategies, visual models serve as heuristic devices. For example, the Utah Avalanche Center's (UAC, 2014) compass rose (Figure 1) combines recent and relevant information, expert forecasts, and color codes to guide decision making. Ultimately, when skiers use the compass rose in decision making, they rely on the *availability heuristic* and *expert halo heuristic* (Rodriguez, Rodriguez, & Carielo, 2014; Zajchowski, 2011a). The propensity to privilege recent or impactful information in decision making (availability) and the reliance on opinions or information of perceived experts (expert halo) are part of what makes visual models such as the UAC's compass rose so effective in communicating risk information to outdoor educators and recreationists traveling in avalanche terrain.

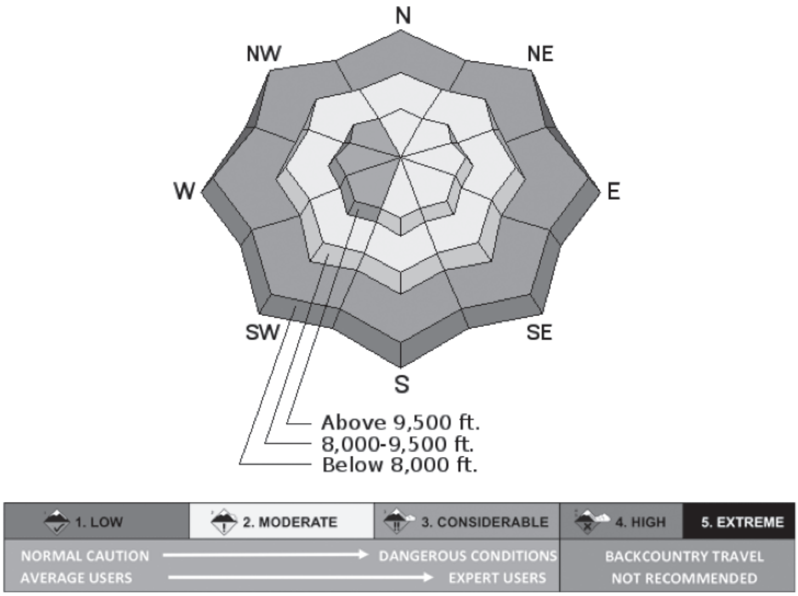

Figure 1. Utah Avalanche Center compass rose and avalanche danger levels. Adapted from "Advisory Displays," Utah Avalanche Center, 2016 (http://utahavalanchecenter.org/).

In sum, whether or not the broader OAE community is aware that these decision-making and educational strategies fall under the "heuristic" label, the ubiquity of cognitive shortcuts as risk management tools and pedagogical aids is undeniable. In other words, mnemonics, parables, simulations and scenarios, as well as visual models, are a set of heuristic devices regularly employed by outdoor educators to manage risk.

Summary

Through exploring the heuristic concept outside of OAE, we see that many scholars and practitioners from various disciplines consider heuristics as fast and frugal (e.g., Gigerenzer et al., 2008) tools that positively assist humans in navigating a complex world. Conversely, the benefits provided by heuristic processing are balanced with the conflicting results in empirical scholarship, which highlight the occasional inability of heuristic processing to provide optimal decisions. We have reviewed this same duality in OAE: Heuristics are central to effective decision making and can also serve as harmful traps and biases. In short, it seems premature to categorically reject heuristic processing as a prudent decision-making method in OAE. Instead, we formulate an alternate hypothesis, an *antithesis*, to further understand the dual nature of heuristic processing in outdoor pursuits.

Antithesis

Upon interrogation of the heuristic concept, we rejected the original thesis: Heuristics are bad for OAE. As we have seen, there are a variety of codified uses of heuristic processing within risk management and decision making for outdoor pursuits. Consequently, we know that heuristic processing cannot be viewed only as harmful for outdoor educators and their students. That said, from previous heuristic processing research in OAE (e.g., Clement, 1997; Galloway, 2005; Shooter & Furman, 2011), we also know that heuristics have the potential to contribute to errors in decision making. This paradox leaves us with the relatively unsatisfying *antithesis* that heuristics can be either beneficial or harmful for outdoor adventure educators. In turn, this presents the question, if heuristics can be both beneficial and harmful in outdoor pursuits, then how should OAE professionals select helpful heuristics and discard or avoid those that are dangerous?

To explore this question, in the following section we focus on two heuristic devices common to avalanche education: FACETS and ALPTRUTh. Within avalanche education, these mnemonics have received substantial scholarly attention for either highlighting or mitigating decision-making errors (McCammon, 2004a; McCammon & Haegeli, 2007). We explore each mnemonic with the goal of learning how certain heuristics can be harmful or beneficial in outdoor pursuits. In doing so, we arrive closer to implications for intentional use of heuristic processing in OAE.

FACETS

The past 10 years of heuristic processing scholarship focused on avalanche terrain has, arguably, been a response to the work of decision-making scholar and former National Outdoor Leadership School (NOLS) instructor Ian McCammon. Following the avalanche death of a colleague, McCammon (2004a) analyzed 715 avalanche accidents that occurred in the United States between 1972 and 2003, to identify decision-making traps. Following the coding of these accidents, McCammon (2004a) identified six heuristics contributing to avalanche fatalities: familiarity, acceptance, consistency, the expert halo, social facilitation, and scarcity (Figure 2). These six heuristics, commonly known as FACETS, dominate the scholarly work, practitioner education, and popular media that focus on cognitive shortcuts in avalanche terrain (e.g., Furman et al., 2010; Page, 2014; Tremper, 2008).

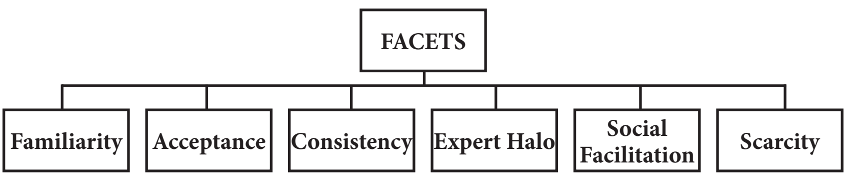

Figure 2. FACETS heuristics present in avalanche terrain. Adapted from "Heuristic Traps in Recreational Avalanche Accidents: Evidence and Implications," by I. McCammon, 2004a, *Avalanche News, 68,* p. 110.

Familiarity refers to an individual's use of past experiences to make decisions within present situations in familiar terrain. *Acceptance* is the tendency of individuals to engage in activities they feel will be approved by their peers or those who they hope to impress. *Consistency* is the propensity for someone to stick with prearranged decisions; these shortcuts often focus on timelines, routes, and descents (e.g., summit fever). Consistency can also refer to attachment to a self or group image. The *expert halo* describes how individuals in a group may rely on the decisions of those perceived to have more experience, skill, knowledge, or assertion (i.e., perceived experts). *Social facilitation* is someone's tendency to decrease or increase the amount of risk he or she is willing to undertake depending on the presence of other group members. Finally, *scarcity,* also known as "powder fever," is the process of ignoring potential risks or concerns in favor of experiencing finite resources, in this case "first tracks" on unskied or freshly fallen snow. These six heuristic traps are commonly known by the acronym FACETS, with the *T* representing "first tracks" in place of scarcity (McCammon, 2004a).

McCammon's (2004b) analysis illustrated that use of FACETS heuristics is contingent on group size and composition, level of formal avalanche training, number of heuristic traps present, as well as risk propensity. He connected accidents with the reported presence of heuristic traps clues that may have influenced decision making. Because of the a posteriori methods used, McCammon was unable to establish causation between specific heuristics and specific avalanche accidents. That said, this potential link between heuristic traps and human-triggered avalanche accidents established a framework for subsequent research, which has heavily influenced practitioner interpretation of the heuristic concept in avalanche terrain (e.g., Furman et al., 2010; Madden, 2011; Page, 2014; Walker & Latosuo, 2016).

ALPTRUTh

In comparison to FACETS, the mnemonic ALPTRUTh (McCammon & Haegeli, 2007) is equally important for risk management in avalanche terrain (e.g., Hallandvik, Langeland, Berger Skjostad, Aase Overbotten, & van den Tillaar, 2012; McCammon, 2006; Powder Magazine, 2014; Tremper, 2008). ALPTRUTh originated from the premise that to confront FACETS heuristics, educators and their students needed more easy-to-implement tools to assess stability in avalanche terrain (McCammon, 2006). Although the effectiveness of ALPTRUTh was initially criticized for omitted data and lack of methodological transparency (Uttl et al., 2010), more recent inquiry has shown ALPTRUTh to be effective in mitigating decision-making errors (Gigerenzer & Gaissmaier, 2011; Hallandvik et al., 2012).

Table 2
ALPTRUTh and Clue Definitions and Questions

Clue	Definitions and questions
Avalanches	Have there been any in the last 48 hours?
Loading	Has there been any by snow, wind, and rain in the last 48 hours?
Path	Is there a noticeable/obvious slide path?
Terrain Trap	Are there gullies, cliffs, or trees that increase the severity of being caught?
Rating	Is there a “considerable” or “higher” section in the avalanche report’s compass rose?
Unstable Snow	Have you heard/seen cracking, collapsing, whomping, or other clear signs of instability?
Thaw instability	Is there any recent warming of snow surface due to sun, wind, rain, or air temperature?

Note. Table adapted from “What Is ALPTRUTh? Clues to Look for, and Remember, When Out in the Backcountry,” by Powder Magazine, 2014, *Powder* (http://www.powder.com/safe-zone/alptruth/).

ALPTRUTh comprises a variety of environmental clues that signal potential avalanche threat (see Table 2) and relies on the recognition and tallying of these clues that ultimately indicate avalanche probability (Gigerenzer & Gaissmaier, 2011). In other words, the more clues, the higher the level of danger; the presence of one or two clues alerts outdoor educators to proceed with caution, whereas the presence of more than four clues indicates that avalanches are highly likely and alternate activities or routes are advised. In learning ALPTRUTh, outdoor educators and their students are primed to recognize and analyze the various components of the mnemonic, which ultimately guide their decision making (McCammon, 2006).

McCammon and Haegeli’s (2007) ALPTRUTh tool is also an “obvious clue” heuristic (Gigerenzer & Gaissmaier, 2011; McCammon, 2006). This tallying of obvious clues is heuristic nature—in the sense that the mnemonic is an efficient tool for decision making as well as that tallying each of the individual components (obvious clues) relies on heuristic processing. For example, decision making based on observation of recent avalanches in the last 48 hours is a classic example of what Kahneman and Tversky coined the "availability heuristic" (Priest & Gass, 2005; Tversky & Kahneman, 1973), whereas use of the compass rose in the avalanche report is a manifestation of McCammon's (2004a) "expert halo." In other words, within ALPTRUTh, heuristic processing is required to assess each of the individual clues of the broader heuristic mnemonic. This nesting of heuristics, much like Russian dolls, illustrates the multifaceted and dual nature of heuristic usage in avalanche terrain. In other words, Kahneman and Tversky's availability heuristic or McCammon's expert halo trap may lead outdoor educators astray; however, within ALPTRUTh, availability and information derived from experts may also lead to effective decision making.

Summary

It appears the *antithesis*—that heuristic processing can be helpful or harmful in OAE—is supported through interrogation of the FACETS and ALPTRUTh heuristics. FACETS comprises heuristics (e.g., familiarity, consistency) that may bias the decision making of OAE professionals operating in avalanche terrain. As such, it is consistent with the dominant view, or *thesis*, that heuristics should be pruned from outdoor pursuits. Conversely, the mnemonic ALPTRUTh cues outdoor adventure educators to assess specific weather events and terrain features that may increase the likelihood of avalanche danger. As a result, ALPTRUTh refutes the original thesis—heuristics are only harmful in outdoor pursuits—and supports the antithesis stated above.

As avalanche education praxis searches to simplify decision making to inoculate recreationists against heuristic traps such as FACETS (e.g., Geisler, 2014), it appears that heuristic devices, such as ALPTRUTh, may be a fitting prescription. Decision-making scholar Pascal Haegeli—without referring explicitly to the heuristic semantic—advocates this course, stating that educators can "make appropriate choices more accessible and more likely for their users by reducing the complexity of decision situations" (Haegeli, Haider, Longland, & Beardmore, 2010, p. 190). By consolidating common heuristic traps into a memorable mnemonic (FACETS) or listing obvious clues for snowpack instability (ALPTRUTh), Haegeli and McCammon have done just that: They created heuristic devices that cue outdoor educators in avalanche terrain to physical and psychological weak layers—helping to buffer against decision-making errors. We further explore this relationship between harmful and helpful heuristics using a *symptom-prescription* frame, which is addressed in the final synthesis.

Synthesis

Following our interrogation of heuristic processing in the *thesis* and *antithesis*, we conclude that heuristics can be beneficial and harmful in outdoor pursuits. From curriculum that instructs avalanche education students to examine "representative" snowpits (Kahneman & Tversky, 1974; Zajchowsi, 2011a) to the use of fast and frugal tools such as "Look, Listen, and Feel" (McBride, 2010), backcountry recreationists are primed by avalanche educators to use heuristics to mitigate and manage risk. One particularly illuminating empirical account of this codified use of heuristic processing lies within Furman et al.'s (2010) a study of decision-making curriculum for avalanche education students. The authors found that the reliance on avalanche reports—a combination of using the most recent and impactful information (availability heuristic) and relying on the opinions and knowledge of experts (expert halo heuristics)—was the greatest determining factor in students' risk management decision making. Thus, it is clear that, alongside its well-documented negative potential, heuristic processing also exists to benefit the backcountry user and OAE professional. Therefore, if heuristics are the problem, they may also be the solution.

Accordingly, in the following synthesis we consider heuristics as the *symptom* of decision-making errors and the *prescription* for decision-making success. This reframing of the heuristic concept may provide solutions for the harmful biases contributing to accidents and fatalities as well as advance recent scholarship that strives to understand the dual nature of heuristics (Leemon & Schimelpfenig, 2005; Madden, 2011). As we saw with ALPTRUTh, much like inoculating an individual with a vaccine, it is evident that a dose of context-specific heuristics (e.g., mnemonics, visual models, scenarios) can positively influence outdoor educators and contribute to risk mitigation. In these final pages, using the symptom-prescription frame, we provide three considerations—*metacognitive priming, scale development,* and *ecological rationality*—each of which may help OAE professionals navigate the duality of heuristic processing.

Metacognitive priming. The symptom-prescription frame for human-factor accident and incident mitigation highlights positive and negative roles of cognitive shortcuts and consequently informs the generation of new heuristic devices. Heuristic mnemonics and devices, such as FACETS and ALPTRUTh, have the potential to trigger inventories of decision-making tactics and assumptions. These devices encourage metacognitive priming and give OAE professionals tools to arrest the heuristic decision-making process with minimum cognitive effort. Thus, it may be possible to prescribe a heuristic mnemonic to confront a heuristic trap by creating additional devices that encourage "metacognition"—how we "evaluate and control our cognitive processes" (Dunlosky & Metcalfe, 2009; Schumann, Sibthorp, & Hacker, 2014). In short, creating and testing new types of heuristic devices that encourage metacognition may help move OAE professionals from unconscious heuristic decision-making processes (System 1) to rational, deliberative decision making (System 2). For example, Kurt Lewin's "Change Model" may be a particularly useful guide to assist avalanche educators and their students in "unfreezing" their mental models and acknowledging heuristic shortcuts present in their decision making (Zajchowski, 2011b). In sum, quasi-experimental designs in low-risk scenarios, as well as comparative case studies, would be appropriate avenues to test new types of heuristic devices that encourage metacognition and ensure participant safety.

Scale development. To create effective heuristic devices (prescriptions), additional and more precise research tools may be needed. For example, the FACETS mnemonic identified six heuristics contributing to avalanche fatalities, but the OAE community does not have valid psychometric tools (e.g., scales, indices) to evaluate quantitatively when and where these heuristics are used as well as to what extent they are employed by specific populations. Without a transportable *FACETS scale* that allows researchers to evaluate to what degree and for whom each heuristic strategy is present in decision making, comparisons of the prevalence of heuristics across divergent environments (alpine vs. river) or populations (novice vs. expert) are reliant on qualitative techniques, postaccident investigations, and a posteriori methods.

Opportunities abound to develop, test, and refine a FACETS scale that is valid and reliable across settings, populations, and times (e.g., pre- and postexperiences). A quantitative scale would allow researchers to model and understand the statistical correlates and predictors associated with outdoor educators' use of specific heuristics. These correlates may include self-perceived or actual skill level, experience use history, task-orientation/ego-orientation, setting conditions or recreation specialization (e.g., Beardmore, Haider, Hunt, & Arlinghaus, 2013; Driver, Hopkins, & Peck, 2008; Manning, 2011). That said, without a FACETS scale, these potential correlates and predictors remain unconfirmed. Furthermore, such a scale would also allow researchers to evaluate when specific heuristics (familiarity) and combination of heuristics (familiarity and social facilitation) lead to accident mitigation or occurrence. Ultimately, such a scale would allow researchers to understand a heuristic composition more fully and assist OAE organizations in refining their training modules. Furthermore, such a scale could be used to generate decision-making profiles of outdoor educators or guides, thus highlighting the specific heuristics used (or avoided). This information could lead to individualized context-specific training and support and the potential to reduce field-based accidents and incidents.

Ecological rationality. The consideration of context leads to perhaps the most significant implication arising from the symptom-prescription frame. Just as specific heuristic devices (e.g., SERENE, ALPTRUTh, Reach-Throw-Row-Go) can and should be prescribed for specific task environments, certain environments may also be incongruent with certain heuristics. In other words, part of the failure of any heuristic can be attributed to the environment in which the shortcut is applied (Gigerenzer & Gaissmaier, 2011). Naturalistic decision-making psychologist Gary Klein asserts that the presence of environmental cues and the operator's ability to learn these cues largely defines the success of a heuristic. In other words, according to Kahneman and Klein (2009), the more static an environment and the more time an individual has in that environment, the more successful the heuristic strategy. This type of an environment is referred to as a "high validity" environment, whereas a "low validity" environment has greater uncertainty in cues (Kahneman & Klein, 2009). This applicability of a heuristic strategy to an environment, *ecological rationality,* provides another insight into the role environments play in heuristic efficacy (Gigerenzer & Gaissmaier, 2011; Simon, 1990). For example, outdoor educators are regularly primed to be wary of the weekend warrior, who brings the tools of the boardroom into the outdoors to find these tools incongruent with the challenge and task setting (e.g., Ramos, 2015).

Just as medical professionals must be aware of environmental concerns in diagnosing and prescribing specific treatment (Groopman, 2007), so too must OAE professionals view specific heuristic strategies contextually. Therefore, further inquiry focused on the ecological rationality of specific heuristic strategies in OAE is particularly prudent (e.g., Goldstein & Gigerenzer, 2002). The common misconception in OAE—that high levels of uncertainty imbued in wilderness and backcountry environments breed abject failure for *all* heuristic processing—remains, ironically, uncertain (Gigerenzer & Gaissmaier, 2011). Conversely, as Kahneman and Klein (2009) suggested, the more static an environment and the more time an individual has in that environment, the more successful the heuristic strategy. Both propositions remain largely uninvestigated in OAE and offer ample opportunity for research. In sum, increased understanding of the diverse *task environments* (Gigerenzer, Todd, & ABC Research Group, 1999) in OAE is as important as exploring the cognition of the individual student or educator. Evaluating the efficacy of heuristic devices in diverse task environments (e.g., avalanche terrain, high-volume whitewater) may provide critical information for confronting context-specific heuristic traps and developing contextual heuristic prescriptions.

Summary

In the preceding pages, we highlighted the ubiquity of heuristic processing within OAE, as well as the dual nature of heuristics. Using a dialectical method (e.g., Dare et al., 1987), we explored the dual nature of heuristic processing by questioning a fundamental *thesis* in OAE: Heuristic processing is generally bad for outdoor educators and their students. Next, we developed an *antithesis*—heuristics are situationally helpful and harmful in outdoor pursuits—and compared the respective utility of two heuristic devices used in avalanche education. Our resulting *synthesis* advanced a *symptom-prescription* frame that may assist in designing and propagating heuristic devices to confront heuristic traps. We argue that through diagnosing heuristics symptomatic of decision-making failures, we can tailor context-specific heuristic tools, devices, and prescriptions. In sum, we used a dialectical method to illustrate the complexity of heuristic ontology, explore new avenues for inquiry, and discern the potential value of heuristics in OAE. As a result of these efforts, we assert that simply enumerating heuristic traps or advocating a purge of heuristic usage is not only unwise, but also counterproductive to risk management in outdoor pursuits. Instead, functional literacy with heuristic pitfalls—paired with context-specific heuristic trainings, scale development, and the creation of additional heuristic devices—provides a fertile foundation for risk management praxis.

Last, we invite the reader to consider that the heuristic duality that we have reviewed in avalanche education—through ALPTRUTh and FACETS—mirrors that within the broader OAE field. River runners use USGS flow data to anticipate changing river features and hazards, hikers are primed to recognize colorful trail blazes, and multipitch rock climbers rely on various cues in rock structure for protection placement. Alongside these codified risk management heuristics, many of the same well-documented heuristic traps (e.g., scarcity, consistency, social facilitation) that exist in avalanche terrain are equally present in these contexts. The resulting dual nature of heuristics in OAE is ripe for inquiry across outdoor activities and contexts. Trail blazes for the hiker can be an aid or a dangerous crutch, depending on the situation, circumstance, and level of reliance on their use.

Conclusion

From campfire safety to long-distance hiking, context-specific decision-making heuristics make outdoor recreation safer. This does not discount the mercurial potentiality of heuristic processing, which is so often documented in the decision-making and accident literature. As the understanding of heuristic efficacy within cognitive psychology evolves beyond focusing on the heuristics-and-biases school (see Gigerenzer & Gaissmaier, 2011), so too must OAE scholarship advance beyond its current view of heuristics. A comprehensive appraisal of the role of heuristics within the field liberates experience-based cognition from a solely negativistic potential, which labels intuition and experience-based judgment as inherently flawed and doomed to fail against rational and statistical models. By reclaiming the heuristic label in visual models, simulations and scenarios, parables, and mnemonics, we can begin to refocus heuristic research and education. Those heuristic-oriented failures that will occur, those that will continue to populate news headlines and accident literature, though palpable and potent, should spur the design and improvement of prescriptive heuristic risk management strategies.

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