ABSTRACT: Since its inception the goal of avalanche safety education has been to reduce or eliminate avalanche fatalities and injuries. Education about avalanche phenomena has been shown to be insufficient in helping backcountry travelers avoid incidents. Recent emphasis on human factors and decision making in avalanche safety education attempts to address the psychological factors that influence decision making in avalanche terrain. It is not clear, however, that knowledge about heuristics and subconscious motivation is any more effective in moderating risk taking behavior than knowledge about avalanche phenomena is. In fact, research in the biological sciences indicates that some risk taking behavior may have been genetically imprinted in humans through natural selection as a positive adaptation. It seems paradoxical that behavior that is risky for an individual member of a species could be advantageous for the species as a whole but this principle has been shown to operate for many species and there is at least some evidence that it is displayed in humans. This would have significant implications for the conduct of avalanche safety education. It would seem that some risky behavior is impervious to conscious learning. This paper is a meta-analysis of research in this area and a discussion of the implications for more effective approaches to avalanche education.

1. INTRODUCTION

The goal of avalanche safety education is to prevent injuries and fatalities among winter backcountry recreationists. Presumably, if most winter backcountry users received avalanche safety training and the training was effective, there would be very few avalanche incidents. Despite increasing participation in and sophistication of avalanche education, accidents continue to be a serious problem. The Colorado Avalanche Information Center reported that the winter of 2007-08 may be one of the worst on record for avalanche fatalities in the United States. The present review examines some of the limitations of avalanche training strategies and explores the possibility that some risk-taking behavior by recreationists is genetically based.

2. COGNITIVE TRAINING STRATEGIES

The first efforts at developing a curriculum for avalanche safety education were directed toward providing students with knowledge about avalanche phenomena. An early curriculum (Fredston, Fesler, 1994) relied on the analysis of data from weather, snowpack, and terrain observations. Students were trained to make observations on the above categories, calculate a hazard level based on the data, and take action appropriate to their analysis. This model of the interaction between weather, snowpack and terrain became a staple of avalanche safety education.

2.1 Deficiencies of cognitive training strategies

Case studies of avalanche incidents, however, reveal that typically avalanche victims do not lack information about unstable conditions. Atkins (1996) noted that many avalanche victims chose to proceed into conditions that they knew to be dangerous. McCammon (2000) reported that those with higher levels of training in avalanche safety were more likely to be involved in accidents. In a subsequent study (2002) he found that many incidents involving knowledgeable and experienced victims involved the use of heuristics in faulty decision making. He concluded that rather than analyzing empirical data about avalanche conditions, most backcountry recreationists relied on heuristics to guide their decision making. Heuristics are subconscious rules of thumb that allow people to operate efficiently in everyday life. McCammon maintains that commonly used heuristics that help us navigate daily life can lead to dangerous errors of judgment if applied in avalanche terrain. For example, the heuristic social proof serves well if one is in an unfamiliar social situation: Look around to see what everyone else is doing, do the same thing and, you will probably be alright. If one applies the same principle in avalanche terrain, however, the results may not be...
desirable. Should three backcountry skiers drop into a steep, unstable coulior, following them may not be the best decision.

3. AFFECTIVE TRAINING STRATEGIES

Recognition of the subconscious influences on risk perception and decision making has resulted in a dramatic shift in emphasis in avalanche safety education. The American Institute for Avalanche Research and Education (AIARE) publishes a curriculum (2000) that is becoming widely accepted as the standard for avalanche safety education. It is heavily oriented toward group dynamics and decision making in concert with field observation of avalanche conditions. The AIARE curriculum completely eliminates some of the information about avalanche phenomena that was stressed in previous training.

Adams (2005) has proposed a systems approach to avalanche education that applies a wide range of concepts from the social sciences. She contends that previous educational strategies have broken avalanche safety into a collection of components (a) physical, (b), environmental, and (c) human, which are addressed in isolation. She advocates a holistic approach that considers these factors in relation to one another.

DiGiacomo (2007) has proposed an educational strategy that addresses the beliefs of winter backcountry recreationists as opposed to an analytical approach. He suggests activities such as team building exercises and instructor guided discussions on student personalities as a way to address the non-rational aspect of decision making.

3.1 Limitations of affective training strategies

Though affective training schemes recognize the role of subconscious influences on decision making, they do not appear to have any way of directly addressing the subconscious mind to manipulate its influence on behavior. DiGiacomo (2007) noted that although the concept of heuristics is well known among avalanche educators, there is a dearth of practical techniques that recreationists can apply to their decision making. Knowledge about the psychological bases of decision making seems to be ultimately no different than knowledge about avalanche phenomena. It is merely knowledge about something, and not the power to apply that knowledge to modifying behavior. The strongest evidence for the intractability of behavior to rational thought is from research in economics. Ariely (2009) gives a comprehensive view of the influence of subconscious motivation on economic decision making. It is easy to appreciate the paradoxical nature of subconscious motivation on behavior when the consequences of the behavior are easy to understand in rational terms. One may make a poor economic decision because of subconscious motivation but when conscious, rational analysis is applied to economic options, it is easy to comprehend that losing money is bad and making it is good.

A deficiency of avalanche training strategies that address the affective domain, however, is the assumption that the subconscious mind shares the same value system with the rational mind. When educators speak of subconscious influences on behavior, they do so in terms of distortions of perception or faulty judgment. To the rational mind, all unreasonable risk is bad and mitigation or avoidance of risk is good. Benefits must be weighed against costs. The highest benefits and lowest costs or risk of loss are always best. Recent research in the field of evolutionary biology, however, has shown that some subconsciously influenced human behavior can be motivated by values that are diametrically opposed to those of rational thought. In rational terms, risk is always bad, reward is always good; cost is to be avoided, benefit sought. If the subconscious mind thwarts that equation, it represents an error in judgment. There is evidence, however, that humans may expose themselves to risk as an expression of evolutionarily adapted behavior. In the world of backcountry riding, the cost may often be the benefit and the risk may be the reward.

4. NATURAL SELECTION AND HUMAN BEHAVIOR

Physical adaptation of organisms has been amply demonstrated by the natural sciences and accepted to some degree by lay persons. Behavioral adaptation, despite convincing evidence, has been much less widely accepted. It is beyond the scope of this review to validate the concept that much of human behavior is genetically determined. Several authors: Alexander (1989), Brown (1975), Goldsmith (1991), Symons (1992), and Tooby and...
Cosmides (2005) have explicated findings in the field of evolutionary psychology. Pinker (2002) provides an excellent overview of recent discoveries in the biological sciences as they relate to the social sciences such as education and sociology. An examination of the research in this field will lead to two conclusions: Much of human behavior is genetically determined, and often that behavior does not make sense in rational terms.

An example of adapted behavior that is counter to rational values is the handicap principle (Zahavi, A. and Zahavi, A., 1997). This describes behavior that puts individuals at risk in order to realize gains in natural selection. The most straightforward example of this principle, called costly signaling, is prey species that call attention to themselves in the presence of predators. The behavior makes no rational sense. An individual that is vulnerable to predation should logically attempt to hide its presence from predators. The action of costly signaling, however, is a message to the predator that the prey has more than adequate physical strength and skill to elude the predator, and a chase would be a waste of effort on both their parts. This display of prowess is also a demonstration of genetic superiority to rivals and potential mates of the signaler. The individual thus increases his chances for reproductive success and passes both the physical superiority and the signaling behavior to his offspring.

Costly signaling would not work if the inevitable losses of some signalers were not overcome by reproductive gains. Grafen (1990a, 1990b) provided a mathematical model that established the validity of costly signaling as an adaptive mechanism. Smith, Bird, and Bird (2003) demonstrated the action of costly signaling by humans in a study of turtle hunters among the Meriam people in Australia. The members of this society pursue various occupations and the researchers determined that those who engage in the most dangerous, sea turtle hunting, enjoy greater status and reproductive success.

Human behavior is infinitely complex. Some decisions and actions are clearly mediated by conscious, rational analysis. Other behavior is obviously guided by subconscious motivation. Some subconscious motivation is the result of conditioning, but recent research has shown that human behavior is also influenced by genetics. Much of what we do is programmed into our genes by the process of natural selection. It is an expression of our adaptation to the environment in which humans evolved. I am unaware of any research that tests the idea that the pursuit of some adventure recreation activities are an expression of costly signaling. An examination of these activities, however, reveals that they exhibit the characteristics and function of costly signaling. Backcountry skiing and boarding require physical, mental and emotional prowess. The practice of these sports can be seen as a demonstration of that prowess and genetic superiority to rivals and potential mates. The only way to directly test whether deliberate exposure to risk among backcountry recreationalists is an expression of costly signaling would be to catalog the mating behavior of this group and determine if they enjoy greater social status, mate at younger ages with more mates and produce more offspring. There would probably be some ethical issues with this type of research. It seems reasonable to assume, however, that costly signaling may be operating in extreme outdoor pursuits because of both the cost: exposure to risk, and the signaling: the inevitable presence of video cameras to record and broadcast these exploits.

5. CONCLUSION

Education about avalanche phenomena may protect people who are completely unaware of the danger of avalanches. Exercises in communication, decision making and group dynamics may benefit recreationists who are risk averse and amenable to modifying their behavior. I believe, however, that since some risk-taking behavior is genetically based, there is a limit to the ability of avalanche safety educators to influence the decision making of their students. We may have to accept the fact that some avalanche accidents are an inevitable expression of genetically programmed behavior.
References


