ABSTRACT

Extreme sports, defined as sporting or adventure activities involving a high degree of risk, have boomed since the 1990s. These types of sports attract men and women who can experience a life-affirming transcendence or “flow” as they participate in dangerous activities. Extreme sports also may attract people with a genetic predisposition for risk, risk-seeking personality traits, or underlying psychiatric disorders in which impulsivity and risk taking are integral to the underlying problem. In this report, we attempt to illustrate through case histories the motivations that lead people to repeatedly risk their lives and explore psychiatry’s role in extreme sports. A sports psychiatrist can help with therapeutic neuromodulation with “positive” reinforcement potential elicited by dopamine, serotonin, epinephrine, endorphins, and stress hormone hypothalamic-pituitary-adrenal axis activation, which produces a state of optimal arousal. The dopamine and norepinephrine neurotransmitter surge may help to modulate behavior, reversing under-activation in the dorsolateral prefrontal cortex and dysregulation of multiple brain pathways.

INTRODUCTION

Extreme sports are leisure activities that involve major risk to life and limb. The lay perception that extreme sports participants are primarily thrill-seeking, adrenaline-addicted youths may be oversimplified. Investigators have narrowed the definition to refer only to sporting activities during which “a mismanaged mistake or accident would most likely result in serious injury or death.”

Participation in extreme sports may suggest a powerful, life-affirming, and enhancing transcendent primal drive akin to attainment of a “flow experience.” Conquering the “death wish” (Thanatos drive), overcoming paralyzing fear, and searching for a transformative or “life wish” (Eros drive) are considered integral motivators for the extreme sportsperson. Available leisure time; abundant finances; and sophisticated yet affordable equipment attract upper and middle class participants, enabling them to temporarily escape constrained socially acceptable and defined roles and to explore nature and challenge themselves to transcend fear. Gender factors likely play a role in extreme sports. Women have overlapping, but different, motivators for extreme sports involvement, although we are not aware of any strong evidence that addresses this issue.

Some extreme sports activities have been codified and fall under the umbrella of the X Games, whereas others such as wingsuit flying and ice climbing are too challenging and life-endangering to fully integrate into a field that proudly defines itself by bravado.

BASE jumping (jumping from Buildings, Antennas, Spans, and Earth), for example, involves often-illegal risk-taking extreme sport jumping activities and is associated with a fearfully high mortality rate (see Table 1). The term was coined by “the two Phils,” Phil Smith and Phil Mayfield, after their initial parachute-assisted jump in January 1981 from a Houston building. It is worth noting that many sports, including those integrated into the Winter and Summer Olympic Games, share risk factors with extreme sports that place participants at risk for major injury (luge and downhill skiing are two examples). The 2010 death of third-generation Georgian luger competitor Nodar Kumaritashvili during practice at the Vancouver Winter Olympic Games is testament to this fact.

Geneticists have explored possible links between a propensity for high-risk activities and genetic markers. The putative connection of polymorphisms of the D4 subtype of the dopamine 2 receptor, a G protein-coupled receptor that inhibits adenylyl cyclase, with risk-taking, novelty-seeking behavior in humans and other living organisms is a link from a teleologic perspective. The work of Thomson and associates with skiers and snowboarders is especially intriguing. Dopamine is the neurotransmitter most associated with “action,” addiction, and substance abuse. There is a clear link between risk-taking and the dopamine/dopamine/endorphin surge experienced by extreme sports participants. This surge is like the phenomenon seen in gambling and risk-heavy professions such as financial trading, which continually entice participants back to their chosen “edge work.” For participants with severe hyperactive/impulsive attention-deficit/hyperactivity disorder (ADHD), extreme sports can be fairly calming and can even provide therapeutic neuromodulation with “positive” reinforcement potential elicited by dopamine, serotonin, epinephrine, endorphins, and stress hormone hypothalamic-pituitary-adrenal axis activation, which produces a state of optimal arousal.

The dopamine and norepinephrine neurotransmitter surge may help to modulate behavior, reversing under-activation in the dorsolateral prefrontal cortex and dysregulation of multiple brain pathways.
involved in the attentional and impulse control processes.\textsuperscript{19,20} Cloninger’s work on personalities\textsuperscript{21} regarding four dimensions of human behavior (harm avoidance, reward dependence, novelty seeking, and perseverance) serves as a helpful template with which to evaluate the personality structures of those who actively participate in extreme sports. Similarly, Zuckerman’s Sensation Seeking Scale, now in its fifth iteration,\textsuperscript{22} which evaluates four different subscales of thrill and adventure seeking, disinhibition, experience seeking, and boredom susceptibility, provides an excellent framework with which to assess the behavioral traits and functioning of extreme sports participants.

A suicidal level of risk taking may be present in extreme athletes. Dean Potter, a pioneering free climber, slackline walker, and “free BASER,” frequently referred to death. He stated, “You are playing with death then and it feels so good.” About wingsuit flying he said, “[It] turns the impossible into the possible,” and “Instead of dying, I’m flying.” He earned the grudging admiration of rangers and throngs of climbing visitors at Yosemite National Park, where he completed many of his most audacious feats.\textsuperscript{23,24}

Likelihood of affective disturbance or diathesis is much higher in this risk-taking population. Extreme sports participation may serve as a temporary antidepressant, lifting mood at least on a short-term basis, perhaps not dissimilar to the way the anesthetic agent ketamine can potentially help in the setting of resistant depression.\textsuperscript{25} The combination of an endogenous “rush” of multiple neurotransmitters and physical activity greatly amplifies the protective and healthy effect that people involved in “safe” sporting exercise also experience.\textsuperscript{26}

Bike motocross (BMX) participants describe the degree to which an athlete’s desire to pull a never-before-seen trick or stunt outweighs conventional calculations of risk.\textsuperscript{27} Participants in this sport, an X Games favorite, tend to idealize, romanticize, and mythologize extravagant risk taking as “highly motivational passion.” Descriptions include:

“We are not normal people. … In the best sense of the word, we are childlike.”\textsuperscript{28,29}

“His mind was ‘so trigger.’”\textsuperscript{30}

There is a naive explorer’s curiosity vis-à-vis the severe pain response as exemplified by ex-BMX racer TJ Lavin, who said, “I didn’t know we could slam like that,” after breaking both legs.\textsuperscript{31}

When champion BMX biker Dave Mirra retired from BMX in 2011, he said of his younger competitors, “They’ll die. Just like I would when I was younger. I would have died to win.”\textsuperscript{27} In February 2016, Mirra committed suicide by gunshot wound in his car after an argument with friends. A postmortem examination identified chronic traumatic encephalopathy attributable to innumerable concussions sustained during his freestyle BMX career.\textsuperscript{29}

More than 300 BASE jumping-related deaths were recorded between 1981 and 2016; interest in the sport accelerated after 2000 with increased coverage and financial rewards associated with the sport.\textsuperscript{29} The number of wingsuit deaths is unknown, but many of the most prominent proponents and pioneers of this field have died, including Dean Potter and Mark Sutton, who was famous for parachuting as James Bond into the stadium at the opening ceremony for the 2012 London Summer Olympic Games.\textsuperscript{30}

The combination of an endogenous “rush” of multiple neurotransmitters and physical activity greatly amplifies the protective and healthy effect that people involved in “safe” sporting exercise also experience.

### Table 1. Extreme sports and morbidity/mortality risk

<table>
<thead>
<tr>
<th>Type of extreme sport or study</th>
<th>Years</th>
<th>Morbidity/mortality rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE jumping</td>
<td>1981-2015</td>
<td>More than 300 deaths worldwide\textsuperscript{1}</td>
</tr>
<tr>
<td>Swedish BASE Jumping Study\textsuperscript{1}</td>
<td>2002</td>
<td>1 fatality/80 participants; 1 death/2317 jumps\textsuperscript{2}</td>
</tr>
<tr>
<td>Mei-Dan et al (Israel)\textsuperscript{1}</td>
<td>2013</td>
<td>72% witnessed death or serious injury; 43% of jumpers sustained a serious BASE jumping injury; 76% witnessed a “near miss” or narrowly avoided fatality</td>
</tr>
<tr>
<td>Sky diving</td>
<td>2000-2016</td>
<td>1 death/100,000 jumps\textsuperscript{3}</td>
</tr>
<tr>
<td>Scuba diving, Divers Alert Network\textsuperscript{1}</td>
<td>1970-2017</td>
<td>16.7 deaths/100,000 divers per year</td>
</tr>
<tr>
<td>Rock climbing</td>
<td>1998-2011</td>
<td>1 death/320,000 climbs\textsuperscript{4}</td>
</tr>
<tr>
<td>Skiing</td>
<td>2011-2012</td>
<td>1 death/1,351,000 trips (5.5 deaths/million participants)\textsuperscript{5}</td>
</tr>
<tr>
<td>Free diving</td>
<td>2006-2011</td>
<td>417 free diving accidents: 308 fatal, 109 nonfatal\textsuperscript{6}</td>
</tr>
<tr>
<td>Hang gliding, paragliding</td>
<td>1993-2017</td>
<td>In the US, 1 death/560 flights\textsuperscript{7}</td>
</tr>
</tbody>
</table>

CASE PRESENTATIONS

Here we present three cases. To our knowledge, none of the three extreme sport participants described here sought mental health treatment, but we were familiar with each of them. We describe them posthumously, to illustrate the complex constellation of social and psychological factors that probably influenced and motivated each extreme sports participant. In Table 2 we compare these three cases.

Case 1: “Allan”

“Allan,” a 48-year-old married father of 3 teenagers, was a successful businessman and a “pillar of society.” He had a multitude of business and family responsibilities, and he may have felt trapped in his societal roles. Perhaps in an effort to escape these psychological shackles, Allan became a regular “weekend warrior” at a local hang-gliding site. He was extremely careful with his equipment, meticulously prepared, and had a strong awareness about local wind patterns. He died of severe injuries sustained after being buffeted by a strong, unexpected gust of wind that threw him against a cliff face and caused a crash. His death was perceived as a major tragedy by his family and community.

The crash location was associated with well-known risk; at least three serious injury events occurred each year at the site, and yet Allan, like many other thrill seekers, was willing to take this risk. People at his funeral emphasized that he loved the excitement and sense of freedom the flights provided. Grief management, counseling, and individual and family support cannot replace the ongoing role that Allan would have had as a father, husband, and community leader.

Case 2: Dean Potter

Dean Potter, the youngest of three sons, was born in the Midwest to a military father and a free-spirited mother, an RN and a yoga teacher who had embraced an alternative lifestyle. His father was described as a deeply caring, family-oriented man. His mother was described as flighty. When he was seven years old, Dean’s parents separated and had shared custody of the children.

His first climbing experience was as a four-year-old in the West Bank while his father was a peace keeper in the Middle East.33

Dean described his childhood as difficult. In school, he was often in trouble, largely because of his challenges with attention and impulsivity. His family did not seek therapy or psychiatry to address his behaviors, which were consistent with combined-type ADHD. Dean was also painfully shy, withdrawn, and socially isolated from peers. He described himself as having resentment toward others as a youth because he felt excluded and shunned, although his feelings may have been only partially based in reality. Dean finally established his first friendship when he and another boy snuck into a restricted area on his father’s Air Force base in New Boston, NH, by climbing a 200-foot cliff.34 Dean easily and fearlessly climbed the cliff without a rope and established his life’s path. He described rock climbing and free soloing (climbing without safety gear or ropes—a fall causes serious injury or death) as “perfect,” spiritual experiences.32 Dean went to college in NH and continued to struggle to find a peer group with which he could mesh.

Despite not feeling at ease, Dean forced himself to participate in team sports. He summarized his attitude toward his crew team as “destroy everybody and establish my dominance.”35 Shortly after Dean left school and started rock climbing full time at age 20, he found himself drifting around the western US, finally settling down in the Yosemite National Park area. He described several vivid spiritual dreams and hallucinations, which began in early childhood, that involved flight and ravens. He had vivid hallucinations, or visions, of being a shamanistic raven in an area of Hueco Tanks State Park.

Table 2. Case presentation comparisons

<table>
<thead>
<tr>
<th>Categories</th>
<th>Case 1: “Allan”</th>
<th>Case 2: Dean Potter</th>
<th>Case 3: Dan Osman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline social functioning</td>
<td>Excellent</td>
<td>Fair to limited</td>
<td>Variable/poor</td>
</tr>
<tr>
<td>Risk for extreme sports</td>
<td>Medium</td>
<td>Very high</td>
<td>Very high</td>
</tr>
<tr>
<td>Level of skill attained at chosen extreme sport</td>
<td>“Weekend warrior”</td>
<td>Elite professional</td>
<td>Elite professional</td>
</tr>
<tr>
<td>Relationships, family stability</td>
<td>Fairly good</td>
<td>Relatively unstable</td>
<td>Moderately unstable</td>
</tr>
<tr>
<td>Genetic predisposition for risk taking</td>
<td>Unknown</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Treatment history</td>
<td>No known treatment</td>
<td>No known treatment</td>
<td>No known treatment</td>
</tr>
<tr>
<td>Presumptive psychiatric diagnosis</td>
<td>Dysthymia (persistent depression); rule out ADHD; rule out SUDs, partner/relational problems, and generalized anxiety disorder</td>
<td>Impulse control disorder, ADHD, generalized anxiety disorder, conduct disorder, parent-child problems, narcissism; rule out bipolar disorder 1 (manic with psychotic features); rule out SUDs</td>
<td>ADHD, severe conduct disorder, cluster B personality traits; rule out SUDs</td>
</tr>
<tr>
<td>Expressed suicidality</td>
<td>Unknown</td>
<td>Extremely cavalier</td>
<td>Very cavalier</td>
</tr>
<tr>
<td>Conscious awareness of likelihood of death</td>
<td>Risk taker aware of life-endangering nature of sport, embraced the thrill-seeking component of his sport</td>
<td>Fatalistic, intimately aware, and embracing closeness to death as part of the excitement and challenge of his sport</td>
<td>Enjoyed the ability to “cheat” death and felt “bulletproof”</td>
</tr>
</tbody>
</table>

ADHD = attention-deficit/hyperactivity disorder; SUDs= substance use disorders.
near El Paso, TX, that is sacred to Native Americans and to climbers. Many of his peers thought these visions were brought on by substance use, but, although he did “dabble,” Dean denied these claims. Over time, despite his proficiency and ability to climb at high skill levels, his ability to gain prominence in traditional climbing circles was limited, causing him to become somewhat disillusioned.

But Dean did have a competitive drive to be famous, well recognized, and unique; consequently, he cultivated a passion for riskier, more life– endangering activities such as free soloing, high–lining, BASE jumping, and wingsuiting. Worldwide attention, accolades, and sponsorships were finally available to him. In public, Dean presented a spiritual and charismatic persona. However, accomplishing these feats necessitated access to a primal motivation that led to his nickname, “The Dark Wizard.” Fiercely competitive and proud, he was prepared to go to extreme lengths to protect and extend his records and accomplishments. Impulsively climbing in illegal national park sites cost him and his then–wife several sponsors including Patagonia, loyal supporters, and alienation of potential backers.

Potter died in 2015 while attempting a risky, illegal, and never–before–performed wingsuit flight through a notch on a granite face at Yosemite National Park; an acolyte, 29–year–old Graham Hunt, also was killed. Potter was 43 years old and had inspired generations of young climbers and extreme sports enthusiasts.

**Case 3: Dan Osman**

Dan Osman was born in Orange County, CA, in 1963. He had a strong genetic and environmentally supportive background in risk–taking. His father was a former SWAT team officer and detective. His mother was a former world– champion rodeo barrel racer and a horse trainer. A paternal descendant of Samurai families in the Takeuchi Clan, Dan was trained in the Samurai Bushido code of ethics by his father and studied aikido and kung fu, but he did not feel worthy of the katana sword he received in 1994. Dan probably had untreated, fairly severe combined ADHD and as a child was nicknamed, “Danny I forgot.”

When Dan discovered rock climbing at the age of 12, he considered himself a slow learner, taking 8 years to achieve the elite Yosemite grade of 5.12. Dan became known for his bold (some would say senseless), reckless climbing, ice climbing, free soloing, and speed climbing (to which his many YouTube videos attest). Because some ascending routes he pioneered were subsequently downgraded in terms of difficulty, Dan increased the challenge by working on speed free soloing, once racing up a 400–foot rock face, ropeless, in 4 minutes, 25 seconds. While bolting a new route in Lake Tahoe, he discovered his love of falling and began to engage in large roped falls. As time progressed, he became bolder and enjoyed mastering falling and associated fears and other emotions. Dan often encouraged others to attempt his feats, and when his 25–year–old friend Bobby Tarver died during a jump, Dan quickly dismissed the event as “pilot error.”

Although Dan was often credited with being meticulous and extremely focused when it came to his rope jumps and solo climbs, the rest of his life was marked by impulsivity, disorganization, forgetfulness, illegal jumps, brushes with the law, and episodes of brief jail time.

Friends began to refer to him as being on “DANO time,” as he often arrived hours or even days later than expected. His father eventually told Dan that he would no longer bail him out for his continued minor legal infractions such as unpaid parking and traffic tickets. Friends picked up the slack, but Dan’s Bohemian lifestyle did not make it easy for him to maintain relationships or care for his daughter. Part–time carpentry and climbing were not lucrative occupations.

Dan was excited to be included in the Guinness World Records for speed free climbing, and for rope jumping 1000 feet. Aware of the danger, after the record jump he stated on video, “I’ll give my guardian angels some time off because they’ve been doing a heck of a job.”

After being released from a brief incarceration, Dan returned to Yosemite and the site of a jump he had performed several months earlier to take down the rigging and ropes. He must have noticed that winter snows and intermittent freezes had substantially damaged his rope system. Dan could not resist his impulses despite warnings from friends and attempted an 1100–foot fall. This time, the rope broke at the 900–foot mark, the spot at which the safety knot had been tied from his autumn jump. Dan died in 1998 at age 35, leaving a young daughter.

**MANAGING RISK IN EXTREME SPORTS**

Overlearning and practicing skills safely until they become automatic is critical when people participate in high–risk, high–skill activities such as mountain or boulder climbing, alpinism, and other extreme sports. The only way to succeed is to keep practicing toward the goal of reaching the top. It often takes a long time to unlock the sequence of movements to complete the combination required for a particular climb.

The process of practicing in grueling, risky conditions often is just as rewarding for a dedicated climber as the goal of reaching the top or succeeding at any highly challenging task. An essential part of this process is mindfulness, the quieting of the mind. As a free climber pointed out, “It puts me into a position where I can concentrate and be more mindful than any other thing I do. … The act of climbing without a rope has been very valuable, in that it’s been one of the things I can do to truly force me to quiet my mind.” Another participant points out, “… it’s such a hyper–focused and, at the same time, calming experience.”

Extreme sports are generally performed outdoors in natural settings. Conditions must be close to perfect to complete an activity or a climb. However, small variabilities in temperature, humidity, sweat response, and light are always factors. For this reason, many successful climbs are completed at night in colder but more predictable and consistent conditions. When conditions are less than ideal, failure; conscious, prudent withdrawal from a climbing attempt; or severe injury or death are much more likely.

In our opinion there is a notable difference between impulsive high–risk takers and cutting–edge, expert, pioneering extreme sport proponents. Both types of participants risk injury and death while exploring their outer skill limits. Highly
trained extreme sport expert proponents have developed the skill set to manage the frustration associated with deferred gratification and have learned to channel rather than be driven by their impulsivity. Climbers such as those who may die on Mount Everest or while free soloing spend years and thousands of hours developing their skills to the point at which they feel ready to attempt a task that is at the peak of their perceived difficulty scale. They believe their level of preparation lowers risk despite the many variables that heighten risk.

Expert proponents probably turn away from an activity if conditions are not perfect. They use ropes to climb the most difficult sections numerous times before gaining the expertise and confidence to even attempt a climb without ropes. Peter Croft and Alex Honnold, who was the first person to free solo climb the most difficult central route up the El Capitan vertical rock formation in Yosemite National Park in June 2017, are both proponents of this approach.

Two examples of successful, very high-risk athletes/stuntmen who enthralled the world were Felix Baumgartner, who free fell and parachuted from Earth’s stratosphere in October 2012 at speeds upwards of 800 miles per hour (Mach 1.2), and Luke Aikens, a third-generation skydiver who free fell from 25,000 feet into a net in July 2016. Sport and adventure psychologist Michael Gervais, PhD, a consultant on free fall attempts, perhaps put it best when he said, “Those that are pushing into territories that are yet to be conquered, we need them to tell us what is possible and truly explore what is not yet known.”

Baumgartner’s humble comment before he left the safety of his parachute capsule exemplified the extreme sports mindset when he said, “Sometimes you have to be up really high to understand just how small you are.”

The roles for primary care and sport psychiatry in extreme sports

Primary care physicians must become knowledgeable about extreme sports and the associated signs that warrant referral to therapists and psychiatrists. While taking patient histories, physicians should solicit descriptions of all leisure activities, not just “regular” sporting activities. Physicians who develop an alliance with physically healthy patients with incipient psychiatric illness can help to foster their long-term mental health.

The current role of the psychiatrist in extreme sports is probably underutilized and is evolving. Sports psychologists can help participants with motivation and mindfulness skills to prepare for highly risky situations. Participants in extreme sports are aware of their risks and most likely are somewhat contemptuous or dismissive of the role that mental health professionals may play other than in performance enhancement. Consequently, extreme sports enthusiasts may avoid accessing psychiatric services. There also is high risk for ego-syntonic polysubstance use, abuse, and dependence in this population. Substance use and abuse may play a part in the ability to overcome the fear of performing some of these activities. Extreme sports participants need to know that psychiatric services are available and that expressing their concurrent challenges, concerns, or traumas may prove helpful.

The ability to harness and even normalize a quasisuicidal “death wish” to perform activities suggests that friends and family can encourage consultations with sport psychiatrists. At the very least, therapy may help participants articulate and understand the motivations at work and identify ways to minimize risk. Supportive involvement does not always denote agreement with the extreme project at hand. Support may lead to an intervention whereby an actively suicidal and perhaps manic or psychotic person can be hospitalized and stabilized or successfully treated as an outpatient. Identifying alternative yet high-action safer activities that extend survival may be considered in a therapeutic environment. Patients with associated Axis II disorders may benefit from interventions such as Dialectical Behavior Therapy.

Dean Potter’s articulation of this Icarus-like statement is telling: “I know it’s insane to think I could fly, but to make it possible, you truly have to believe in it—to go to a place that’s not accepted.” Despite their life-endangering behaviors, most of these athletes do not intend to die, at least from an overt cognitive standpoint. Using medications to manage any underlying Axis I psychiatric disorder such as severe bipolar disorder with psychotic features, major depression, uncontrolled substance abuse or dependence, or severe hyperactive/impulsive ADHD may enable safer execution and fine-tuning of the choices these athletes make while participating in extraordinary activities. Psychiatry and sports psychiatrists, in particular, must acquire a deeper understanding of this fascinating field.

Disclosure

The author(s) have no conflicts of interest to disclose.

Acknowledgements

The authors thank the anonymous reviewers of The Permanente Journal for their excellent suggestions.

Brenda Moss Feinberg, ELS, provided editorial assistance.

How to Cite this Article


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