

# High Risk Sports, Psychology and Virtual Reality- “Living on the Edge”

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## ABSTRACT

**Keywords:** High Risk Sports; Extreme Sports; Stress Research; Psychophysiology Attachment Research; Virtual Reality

**Abbreviations:** RTI: Risk Taking Inventory; SEAS: Sensation Seeking, Emotion Regulation and Agency Scale; AAP: Adult Attachment Projective Picture System; SNS: Sympathetic Nervous System; HRSST: Heidelberg Risk-Sport Specific Stressor Test; VR: Virtual reality; VR: Virtual Reality

## Introduction

For several years there has been an enhanced interest in physical activities, which offer unusual and intense sensations, most often called as high-risk or extreme sports. Indeed, the practice of extreme sports with risk taking seems to be increasingly popular and participation rates have grown exponentially over the past decades [1]. According to Buckley [2] extreme level activities involve higher skill, focus, and risk and the continuous application of highest-level skills and concentration in order to avoid any error. In many activities, any error is likely to cause an immediate and irremediable disaster. Falling on a free solo climb, or hitting a cliff during proximity wingsuit flying, commonly permits no recovery or rescue. Though extreme sports like freeriding, freediving, skydiving, base-jumping and wingsuit flying are associated with a high mortality risks, these activities have become more and more socially acceptable. Participant motivations have mainly been explained through a range of psychological, genetic and sociological frameworks [1,3] however researchers and practitioners have to gain a further understanding multifaceted nature of motives [4]. What is the reason for people's enthusiasm for participating in nerve-racking and often life-threatening situations? What is

the psychological background and physiological basis of these participants, and are there different types of individuals who are attracted to extreme sport with different degrees of risk taking? To answer these questions a multidimensional approach that complements existing research might be appropriate. In the following review we will summarize recent research work in that field and suggest a new research approach including the methods of virtual reality simulation.

## Review of Recent Research Works

### High-Risk Sport and Psychological Research

Several psychological aspects have been recently described to play a role in the participants' motivations for high-risk sport, like sensation seeking, suicidal levels of risk taking, psychiatric diagnoses, and familiar background [3]. The need for thrill and adventure is considered as one major reason why people engage in risk sports. Sensation seeking is defined as the need for varied, novel, and complex sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences [5] and several studies reported that participants of

high-risk sports demonstrate a higher need for stimuli (sensation seeking) than others [6,7]. Several authors examined the associations between risk-taking and emotion regulation [8-10]. Castanier et al. [8] interpreted the participation in high-risk sport activities as a potential strategy to redirect attention away from their underlying low self-esteem. Woodman et al. [9,10] validated useful measurements to identify different facets of participation. For the first time, the RTI (Risk Taking Inventory) combined features with a variety of other related traits (sensation seeking, behavioral activation, behavioral inhibition, impulsivity, self-esteem, extraversion and conscientiousness). Furthermore Barlow et al. [11] developed the Sensation Seeking, Emotion Regulation and Agency Scale (SEAS), a measure of motives for behavior whenever sensation seeking, agency, or emotion regulation. Their results showed a different motivation between the two analyzed groups of skydivers and mountaineers. The authors suggested that researchers should consider risk takers as a more heterogeneous sensation-seeking group.

It has also been pointed out that people who participate in high-risk sports have tendency to emotional instability and impulsivity [3, 12]. Other researchers focused on emotional characteristics of athletes [13] and attachment orientations [14] in individuals participating in risk sports. Bekaroğlu & Bozo [14] examined the role of attachment styles in association with health-promoting behavior in extreme athletes and non-extreme athletes. As expected, extreme athletes tended to be in the "low anxiety and harmful to health" range, whereas non-extreme athletes were in the "high anxiety and beneficial to health" range. Recently Blacker [15] analysed Basketball Players in terms of their attachment styles and performance under stress. Research question was, if attachment orientation would predict performance under pressure on a sport motor task. He found that insecurely attached athletes might be more susceptible to performance deficits under competitive stress compared to securely attached athletes.

Even though only individuals with either anxious attachment style or avoidant attachment style were examined in these studies, individuals with higher attachment related dysregulation (i.e. unresolved disorganized attachment) were not examined. Thus, future studies should consider all four established attachment patterns using reliable and valid interview measures, like the Adult Attachment Projective Picture System (AAP) [16], which was assessed in large body of experimental and clinical studies to assess divergent correlates of attachment in healthy individuals and patient groups when their attachment system was activated [17-19] Especially in the field of research on risk sports, the AAP as a resource-oriented attachment instrument could provide further insights in the individuals' risk management by associating attachment patterns with risk-taking behaviour.

### High-Risk Sport and Psychophysiological Research

Psychophysiology is an interdisciplinary science examining the relationship between mental activities and physical function

[20]. Most studies focused on the relations between psychological and physical aspects and the interaction among systems (e.g. behavioral, endocrine, autonomic and immune). In sport science this interdisciplinary collaboration is able to optimize training procedures in order to achieve optimal performance results. Scientists used e.g. heart rate variability biofeedback training in combination with psychological testing (concentration, stress and anxiety) to optimize training performance in athletes of different disciplines [21]. Channaoui et al. [22] identified that stress markers like cortisol and alpha-amylase - related to the hypothalamo-pituitary-adrenal axis and the sympathetic nervous system (SNS) activity - were associated with mood and sleep patterns in athletes during major competition. These results contributed to a better understanding of training high-level athletes dealing with stress. Especially salivary alpha-amylase can be considered as reliable and convenient indicator of the adrenergic response to competitive tasks.

Research groups recently work on paradigms to investigate risk-sport specific psychophysiological arousals. Frenkel et al. [23, 24] developed a stress-triggering measurement for defining the difference between High Sensation Seekers and Low Sensation Seekers on a physiological level. Participants had to complete a certain climbing task and different psychological tests. The results showed a significant difference between High- and Low sensation seekers with regard to their cortisol response. Moreover Frenkel et al. [25] developed the Heidelberg Risk-Sport specific stressor test (HRSST) to measure the influence of sensation seeking and mindfulness on stress response to a specific stressor.

Monasterio et al. [26] supplemented this approach with further stress parameters to analyse stress reactivity (measured with cortisol and alpha amylase) in base jumpers. They identified that all three groups with different jumping levels had a relatively weak alpha-amylase level and cortisol reactivity. A broader and more clinical view on psychological and psychophysiological dispositions in participants of high-risk sports were introduced by Tofler et al. [3] focusing on individuals with a genetic predisposition to risks and underlying psychiatric features (e.g. impulsivity). These findings highlight the importance of the individuals' physiological disposition, which are not associated to potential training effects on performance.

### Virtual Reality and High-Risk Sport

In the sense of a digital transformation, virtual reality (VR) has the potential to artificially create all possible situations or spaces and thus enable new perspectives. VR simulations are increasingly administered in different domains. Gokeler et al. [27] e.g. developed a modern medical virtual therapy for treating immersion on knee flexion angles in cruciate ligament reconstruction. This intervention served to improve motor learning abilities. Further virtual applications were also found in training science and could also be used in performance coaching. The increased training effect led significantly to skill improvement [28]. Previous studies indicated that artificial stress initiated via VR is comparable to

stress induction “in vivo”. A study using the established Trier Social Stress Test (TSST) in vivo and the adapted VR TSST showed a comparable increase of endocrine reaction in the participants [29]. The authors concluded that the modified and new VR approach for stress induction is a valid and promising method.

In the clinical field VR methods are assessed in alternative therapies focusing on the improvement of the individuals’ well-being and the alleviation of depressive symptoms in the context of palliative care using computer generated environments and avatars [30]. In this study design the authors suggested that patients treated with VR-conditions will show higher scores in their well-being compared to non-VR conditions. Moreover, this approach opens new potentials for pain therapy [30]. Hunnicut and Felipe [31] demonstrated the fruitful use of VR Therapy for vestibular rehabilitation by the means of balance training in order to prevent risk of falling. Other studies emphasized the usefulness of VR for the elderly to improve the quality of life through sport, exercises and leisure activities in a safe and virtual environment [32]. In sum the use of VR is increasing in different domain, however application of VR in the field of high-risk sports research is still pretty rare and requires further intensive research.

## Conclusion

The overview on the psychological and physiological research on participants in high-risk sport demonstrated an increasing interest of this field, however there still some unanswered questions to better understand the complexity of the underlying motives of these participants by combining different perspectives. Virtual reality (VR) is an established computer technology aiming to replicate or modify in a users’ physical presence in an illusory, yet representative setting. VR has been widely used in different domains like psychology, health care and training purposes in sport science.

In our view, future studies with participants of high-risk-sports should assess established psychological measures and the individual’ psychophysiological reactions including a virtual simulative major stress induction (e.g. during a wingsuit flight). In this kind of study design several groups of individuals might be compared (e.g. high-risk sports athletes, non-extreme athletes and non-athletes). This approach is considered to identify possible ranges of different psychological motives and psychophysical predispositions. It is expected that risk athletes have a different stress reaction to non-risk athletes. To induce and test this in a standardized and complex way a combination of visual and vestibular senses using virtual reality and a simulation of a risky athletic situation might be used. Besides various established stress indicators like cortisol, biofeedback and alpha-amylase, psychological tests procedures like seeking behaviour, attachment patterns (considering the whole spectrum of attachment orientations) and individual stress profiles are suggested be evidence-based candidates to better understand the participants’ motivations for high risk sports - “living on the edge”.

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## Conflict of Interest

No conflict of interest.

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