Chamarro Lusar, Andrés; Rovira Faixa, Tatiana; Edo Izquierdo, Sílvia; [et al.]. «Risk judgments in climbers : the role of difficulty, meteorological conditions, confidence and appropriate tools». Leisure Sciences, Vol. 41 Núm. 3 (2019), p. 221-235. DOI 10.1080/01490400.2018.1442266

This is a preprint version of the following article Risk Judgments in Climbers: The Role of Difficulty, Meteorological Conditions, Confidence and Appropriate Tools. Chamarro, A., Rovira, T., Edo, S. & Fernandez-Castro, J., 2019, En: Leisure Sciences. 41, 3, p. 221-235 15. doi.org/10.1080/01490400.2018.1442266

RISK JUDGMENTS IN ALPINE CLIMBERS: THE ROLE OF DIFFICULTY, METEOROLOGICAL CONDITIONS, CONFIDENCE AND APPROPIATE TOOLS

Andres Chamarro*, Tatiana Rovira, Silvia Edo, Jordi Fernández-Castro

*Corresponding author:

Andres Chamarro, Serra Hunter Fellow. Departament de Psicologia Bàsica, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain. E-mail: andres.chamarro@uab.cat

Tatiana Rovira. Departament de Psicologia Bàsica, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain. E-mail:Tatiana.rovira@uab.cat

Silvia Edo. Departament de Psicologia Bàsica, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain. E-mail:Silvia.edo@uab.cat

Jordi Fernández-Castro. Departament de Psicologia Bàsica, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain. E-mail:Jordi.fernandez@uab.cat

Acknowledgements

This study was made possible thanks to the collaboration of the Managing Board of the Spanish Mountaineering Federation.

Funding

This study was supported by the grant SEJ2005-06345 from the Ministerio de Educación y Ciencia, Spain.

Abstract

Risk perception among mountain athletes is a factor that can contribute to injury prevention while maintaining good performance. The objective of this work was to understand how alpine climbers determine their risk perception through combined study of context-specific (ascent difficulty and meteorological conditions) and personal (confidence and the selection of appropriate tools) variables. In this regard, 16 distinct scenarios were presented to 134 alpine climbers and their risk perception related to each situation was recorded. Our findings revealed that their perceived risk was low under favorable conditions: when climbers carry appropriate tools, meteorological conditions are good, and confidence is high. In contrast, the perceived risk was maximal when severe meteorological conditions or inadequate tools were combined with high difficulty ascents. Confidence was found to play a minimizing role over the negative effects of environmental variables as well as difficult or exposed climbing. Our results suggest that alpine climbers may use deliberate rule-based risk appraisal when dealing with risky situations. Moreover, they might be trained to recognize their heuristic behaviors in order to switch to rule-based thinking, thereby maximizing security and performance.

Keywords: Risk judgments, Alpine climbing, decision-making, Confidence, Risk perception.

1. Introduction

Evidence shows that people who practice extreme, high-risk or adventurous sports (e.g., skiing or mountain climbing) expose themselves to the risk of serious injury, which can lead to disability or even death (Chamarro & Fernandez-Castro, 2009; Hasler et al., 2009; Schoffl, Morrison, Schoffl, & Küpper, 2012). Mountain sports and recreational activities have become very popular in the last years (Brymer & Schweitzer, 2013; Furman, Shooter, & Schuman, 2010). Indeed, it is estimated that there is a worldwide total of 100 million high-altitude tourists annually (Burtscher et al., 2001). Therefore, it may not be surprising that this increased number of mountaineers has progressively led to higher accident rates. Notably, this phenomenon has been observed in different countries (e.g., France, Switzerland, United States) and mountain areas (e.g., French Alps, Yosemite National Park, National Parks in Utah and Alaska) (Goulet, Hagel, Hamel, & Légaré, 2007; Heggie & Admunson, 2009). The reason for increased interest in mountain recreation may stem from the wide consensus that practicing sports and physical exercise favors health, especially when the leisure activities provide contact with nature.

1.1. Causes of injuries in mountain sports

The increased injury rates associated with mountain recreation are becoming a public health problem. Therefore, the identification of mechanisms involved in such accidents is of great interest (Deroche, Stephan, Woodman, & Le Scanff, 2012; Hootman, Dick, & Agel, 2007). Hootman, Dick y Agel (2007) described incidence rates of 13.8 sports injuries per 1,000 athlete-exposures in games, and 4.0 in training. With regard to mountain sports, several groups of investigators have already identified distinct factors that contribute to accidents related to skiing (Burtscher & Ponchia, 2010; Hasler et al., 2009), snowboarding (Hasler et al., 2010) and mountaineering (Burtscher, Pachinger, Schocke, & Ulmer, 2007; Chamarro & Fernández-Castro, 2009; Schoffl et al., 2012).

Chamarro and Fernández-Castro (2009) analyzed the variables that cause injury during mountain sports from the perspective of athletes, and four important contributing factors emerged from their study: environmental events (difficulty, weather and mountain conditions), equipment, physical status (mainly fatigue), and behavior (mainly errors and time pressure). Moreover, Schoffl et al. (2012) conducted a systematic review of injuries and accidents in climbing, highlighting the relevance of self-efficacy, difficulty level, experience, and fatigue as risk factors. Their recommendations for preventive interventions were quite similar to those proposed by Chamarro and Fernández-Castro (2009) and included the following: training in climbing techniques/security rules, double checks between partners, route setting, and warm ups. Establishing basic rules has traditionally helped decision-making under difficult circumstances and might be facilitated by specific training in decision-making processes. These results stressed the importance of knowing how athletes make their decisions, which often contributes to injury-producing mistakes. Nevertheless, there is little knowledge about how mountaineers make decisions in their natural setting. Despite the large amount of information that has been provided by websites from the USA, Canada and Europe, injuries have not decreased. Thus, there is growing interest surrounding the development of decision-making abilities as well as efficient algorithms for assessing dangers, which could be employed by novice mountaineers (McCammon & Hägeli, 2007).

1.2. Integration of information about risk

The amount of available knowledge regarding risk factors for mountaineers has increased and become more precise over time. For instance, climbers and hikers now have access to accurate and detailed information about terrain exposure, climbing difficulties and GPS tracks when planning routes. However, there has been limited research about how athletes use this information to estimate risk. Notably, risk perception in mountain sports represents a prerequisite to prevention for two reasons. First of all, an adequate risk perception can prevent people from exposing themselves to situations for which they are not prepared. Secondly, perceived risk is essential for taking appropriate preventive actions. Therefore, it is essential to know how risk is perceived in order to implement effective educational programs that can help mountain athletes and visitors to natural environments avoid unnecessary danger.

Based on the four injury risk factors identified by Chamarro and Fernández-Castro (2009), Chamarro, Rovira, and Fernández-Castro (2010) analyzed the way hikers make judgments by integrating available information about difficulty (i.e., the strength and stamina necessary for progression over the terrain), fatigue, confidence (individual states), and time pressures (i.e., environmental information). These variables represent some elements of the athlete–environment–sport interaction and may be key components in athletes' appraisals regarding situational threats and personal resources. Their results suggested that confidence and fatigue (the individual variables) operated as independent entities, which interacted with difficulty and time pressure (sport and environmental variables, respectively) to determine risk perception. Confidence in their ability appeared to be a protective variable when considering other negative components, such as difficulty and time pressures. These findings could be explained according to the transactional model of stress, as hikers combined primary (severity or level of threat of the situation) and secondary (personal resources) information to determine their level of worry (Guillet, Hermand, & Mullet, 2002; Lazarus & Folkman, 1984). With respect to decision-making, Furman et al. (2010) analyzed the role of heuristics in familiarity, consistency, and acceptance in expert backcountry skiers. These authors found that skiers combined heuristics with avalanche level and risk-taking tendency when selecting a skiing slope. Overall, they concluded that heuristics were preferred over knowledge-based decision tools, which are often slow, tedious, and can yield ambiguous results. Thus, they suggested that safety would not be promoted through adding more information, as skiers preferred to use heuristics instead of complex data. However, since sensitivity to heuristics appears to decrease with training and experience, the authors recommended that research should be conducted on the differences between deliberative and heuristic-based models of decision-making. According to Rulence-Paques, Fruchart, Dru, and Mullet (2005), one possible variable contributing to sport performance might be the degree to which an athlete organizes and integrates knowledge using a decision-making scheme. Also, as Johnson (2006) suggested, and Chamarro et al. (2010) have proven with mountain athletes, most judgments are made under time constraints. In these situations, knowing cues and rules of judgment schemes may play a critical role by allowing athletes to cope efficiently with the complex demands of the activity.

In a recent investigation into how backcountry skiers evaluate and react in order to avoid avalanche hazards, Chamarro, Marti, Rovira, Carola, and Fernández-Castro (2013) allowed study participants to evaluate hypothetical scenarios, including information about terrain exposure, avalanche risk, and safety gear. The purpose of the study was to determine how information about terrain, objective dangers, and personal resources is integrated to impact risk judgments and decisions on discontinuing the routes. Their results indicated that skiers combined terrain exposure and avalanche risk assessments, as well as avalanche risk and safety gear appraisals for estimating safety. On the other hand, skiers did not integrate terrain exposure and safety gear, or all three variables, during risk evaluation. These findings suggest that even when all of the information is available, variables are not equally considered with regard to risk. In fact, it appears that two information sources may be sufficient for perceiving risk. In other words, they might be "substitutable" pieces of data (Guillet et al., 2002). These results are consistent with those of Furman et al. (2010), adding insight into how information related to the risk perception heuristics is combined and utilized. With respect to decision-making, the results were slightly different, demonstrating that skiers may use all three information sources for adopting their judgments. It seems that when the situation is quite complex, skiers adopt new conclusions in order to avoid prolonged risk exposure (i.e., changing the route). Therefore, decision-making seems to be a more elaborate operation.

1.3 The functional theory of cognition

In order to define the psycho-cognitive laws of information processing and the integration of multiple stimuli to make decisions and form judgments, Anderson (1996) proposed the Functional Theory of Cognition (FTC). The FTC model is based on the notion that people use valuation and integration processes to transform information into a psychological representation, subsequently combining these psychological values into an implicit response. However, this assimilation is possible only after representations have been converted into subjective values having the same metric. Thus, the integration process can be described using simple algebraic operations (averaging, summing and multiplying), whereas the response process involves transformation of the implicit response into an observable reaction.

The FTC has been successfully applied to studies in the fields of health (Edo, Torrents, Rovira, & Fernandez-Castro, 2012; Frileux, Munoz-Sastre, Mullet, & Sorum, 2004; Munoz Sastre, Mullet, & Sorum, 2000) and sports (Chamarro et al., 2010; Fruchart & Mullet, 2012; Rulence-Paques et al., 2005). This method also appears to be applicable to stress assessment (Guillet et al., 2002) because the theory emphasizes the role of personal judgment in stressor (threat) prediction (i.e., judgments regarding situational stress, personal resources, and environmental strain).

The FTC is typically tested using the factorial survey method, which combines the advantages of an experimental design with those of experimental research (Shooter and Galloway, 2010). In factorial survey studies, subjects receive a variety of hypothetical vignettes describing specific circumstances, such as consultation situations (Müller-Engelmann et al., 2013). These vignettes are constructed based on factors that are thought to influence judgment, and the subjects are asked to indicate how the decision should be made using a rating scale. Factorial surveys have been employed to understand real-world decision-making activities, with the goal of developing methods to enhance the decision process (Shooter & Galloway, 2010). In the field of leisure research, Furman et al. (2010) tested various avalanche forecast conditions and heuristic factors that were reported to influence decision-making by asking participants the likelihood that they would ski a slope under distinct conditions.

1.4 Purpose and study hypothesis

The few studies that have analyzed risk perception and decision-making in sports have suggested that athletes often use heuristic processes in the absence of information or minimize data processing (Bennis & Pachur, 2006; Furman et al., 2010). However, an alternative rule-based process for combining available information for risk perception and decision-making is possible. As discussed in section 1.2, there is a lack of understanding of the specific conditions that lead athletes to use heuristics vs. deliberate decision-making. From our viewpoint, this is especially relevant in the case of mountain sports, where erroneous risk perception and decision-making can produce severe consequences for the athlete.

The objective of the present study was to expand on the previous findings of Chamarro et al., (2010, 2013) with alpine climbers, who have a high degree of exposure to hazards. Additionally, alpine climbers need high physical skills and increased capability for recognizing environmental events. Therefore, we determined the degree of perceived risk resulting from the combination of the following variables: difficulty, meteorological conditions, having the appropriate tools, and confidence. Indeed, difficulty and meteorological conditions are two environmental events often mentioned by climbers as causes of injury. In addition, having the appropriate tools, which is the result of previous decision-making processes, is fundamental for all mountaineers (Chamarro & Fernandez-Castro, 2009). Furthermore, confidence must be taken into consideration, as it may influence other negative situational factors (Chamarro et al., 2010). Nevertheless, confidence can also have a negative impact in the form of illusionary overconfidence (Furman et al., 2010).

These variables represent data related to personal, environmental, and technical features associated with climbing/mountaineering, thereby allowing adequate risk appraisal. According to previous research, we might expect several systematic patterns: our first hypothesis is that the combination between any of the situational variables (i.e., difficulty and meteorological conditions) and personal variables (i.e., having the appropriate tools and confidence) will always be multiplicative (Chamarro et al. 2010; Rovira, Edo, & Fernández-

Castro, 2010). In contrast, we might expect that combination between the two situational variables will be additive (Rovira et al., 2010).

2. Materials and methods

2.1. Participants

A total of 134 alpine climbers (16.3% female) were enrolled during formative initiatives performed by sports authorities at the national level. Younger candidates belonged to junior national teams, and aged participants were their instructors, who were accredited by national sports authorities (Spanish Federation of Climbing and Alpinism) and had experience at the Himalayan level. Mean age of the sample was 32.59±8.01years old (range: 18–56 years), and participants had a mean experience of 10.79±8.015 years.

2.2. *Measures*

Athletes were asked to self-report age, gender, actual age, and years of experience. In addition, according to the FTC, simulated scenarios were used to represent the kinds of information that participants may be confronted with during an ascent. Sixteen scenarios were designed by systematical combination of each of the four variables (i.e., difficulty, meteorological conditions, having the appropriate tools, and confidence), which each had two levels. Regarding the difficulty variable, the respective low and high levels were defined as follows: "The way is easy" and "The way is difficult". Concerning meteorological conditions, the respective favorable and less favorable levels were represented by the following descriptions: "The weather is fine" and "The weather is bad". For climbing tools, the respective conditions were presented as "You are carrying the appropriate tools" and "You don't carry the appropriate tools". Finally, with regard to confidence, the variables were "You feel confident” and “You don`t feel confident”. For example, a scenario that corresponds to most unfavorable levels in all variables is the following: “You are doing an ascent with your habitual teammates. The way is difficult. The weather is bad. You don’t carry the appropriate tools. You don`t feel confident”.

Each scenario was presented on a separate sheet of paper, and participants were asked to rate to what extent they would feel worried under the specific conditions. They gave their level of worry based on an eleven-point Likert scale, with choices ranging from “hardly any worry” to “extremely worried”. Slovic, Finucane, Peters, and MacGregor (2004) have suggested that worrying is a variable response that is related to the experiential dimension of our thinking and involves the negative affective state associated with the activity. For them, the affective state represents the path to the judgments we make, especially when the behavior is complex.

2.3. Design

Based on the methodology of simulated scenarios, the two different levels for each variable gave rise to a within-subject experimental design of 2x2x2x2, in which the scenarios were presented randomly. Indeed, use of this within-subject design ensured that all of the participants experienced all of the conditions, allowing us to control possible individual differences.

2.4. Procedure

All participants individually rated the scenarios, and the procedure had two phases. In the first, the participants familiarized themselves with the task at hand by responding to six scenarios. Two of these conditions represented the most extreme levels in order to avoid the ceiling and floor effect in the remaining scenarios, and the other four were extracted at random from 16 experimental possibilities. During this phase, the participants were able to ask questions in order to clarify information. Notably, data obtained during this first phase were not used in the subsequent analyses. In the second experimental phase, all 16 scenarios were randomly presented to each participant.

2.5. Data analysis

We conducted an analysis of variance (ANOVA) for repeated measures, with difficulty (low/high), meteorological conditions (fine weather/bad weather), carrying appropriate tools (carrying/not carrying appropriate tools), and confidence (confident/not confident) used as the variables. For significant interactions, we used post-hoc pairwise tests with Bonferroni adjustment for multiple comparisons in order to determine how changes in worry level related to one factor altered based on other variables. Using this analysis, and according to Anderson (1996), we could determine if the information was combined in an additive way (i.e., non-significant interactions: the more variables at play the greater the effect in the resulting judgment) or a multiplicative way (i.e., significant interactions: the effect of some of the variables is multiplied when combined with certain additional variables).

3. Results

We found that the perceived level of worry ranged from 1.86 to 9.69 points, thereby suggesting that any floor or ceiling effects could be discarded. Moreover, our analysis of variance (see Table 1) indicated that the main effects of the four variables were significant. Figure 1 shows that higher levels of perceived worry were related to a high degree of difficulty ($F[1, 133] = 306.67$, $p<0.001$), having a bad weather ($F[1, 133] = 240.24$, $p<0.001$), not carrying the appropriate tools ($F[1, 133] = 322.40$, $p<0.001$), and a low level of confidence ($F[1, 133] = 302.38$, $p<0.001$).

Insert Table 1 about here

Insert Figure 1 about here

3.1. The relationship between meteorological conditions, carrying the appropriate tools, and confidence

Figure 2 presents the relationship between meteorological conditions and carrying the appropriate tools on each level of confidence in order to determine the amount of worry.

Insert Figure 2 about here

With a low level of confidence (right panel), the meteorological conditions had a non-significant interaction with carrying the appropriate tools. However, the level of risk rose with bad weather as a function of having the appropriate tools or not. Indeed, the mean difference of worry between having bad or good weather when carrying the appropriate tools was 1.34 (CI: 1.01–1.66), whereas it was 1.27 (CI: 0.96–1.59) in the absence of adequate tools. In addition, not carrying suitable tools increased the perceived risk under all meteorological conditions. The mean difference of worry between not carrying or carrying the appropriate tools when there was good weather was 1.66 (CI: 1.35–1.97), while during bad weather it was 1.60 (CI: 1.31–1.89).

At a high level of confidence (left panel), the meteorological conditions had a significant interaction with carrying the appropriate tools. A higher decrease in the degree of worry was produced by better meteorological conditions when carrying the appropriate tools in comparison to not carrying them. In this respect, the mean difference of worry between bad and good weather when carrying adequate tools was 2.2 (CI: 1.92–2.49), whereas it was 1.41 (CI: 1.12–1.70) in the absence of appropriate tools.

3.2. Relationship between difficulty and each of the other three variables (meteorological conditions, carrying the appropriate tools, and self-efficacy)

The left panel of Figure 3 shows the level of worry as a function of difficulty and meteorological conditions. Notably, at all difficulty levels, having bad weather increased worry. However, this increase was significantly higher when the way was difficult. The mean difference of worry between bad and good weather was 1.31 (CI: 1.08–1.54) when considering the easy way and 1.80 (CI: 1.55–2.05) for difficult climbs. Furthermore, at all levels of meteorological conditions, climbing difficulty was found to increase worry, especially when the weather was bad. In this regard, the mean differences of worry between the difficult and easy ways were 1.63 (CI: 1.39–1.87) and 2.12 (CI: 1.85–2.38) for good and bad weather, respectively.

Insert Figure 3 about here

The central panel of Figure 3 shows the level of worry as a function of difficulty and carrying the appropriate tools. We observed that not carrying the appropriate tools increased worry at all levels of difficulty, with significantly higher concern stemming from a complicated path. The mean difference of worry between not carrying or carrying the appropriate tools was 1.61 (CI: 1.382–1.85) for the easy way and 2.07 (CI: 1.83–2.31) for difficult way. Whether individuals carried the appropriate tools or not, difficult climbs increased worry; however, this was especially true when lacking adequate tools. The mean differences of worry between the difficult and easy way were 1.65 (CI: 1.41–1.88) when carrying the appropriate tools and 2.10 (CI: 1.84–2.36) in the absence of suitable tools.

The right panel of Figure 3 shows the non-interactive relationship that exists between difficulty and self-efficacy for determining worry level. At all levels of self-efficacy, having a difficult way equally increased the level of worry. The mean differences in worry between the difficult and easy ways were 1.85 (CI: 1.60–2.09) and 1.90 (CI: 1.66–2.15) when there were high or low levels of self-efficacy, respectively. Finally, at all levels of difficulty, having low self-efficacy uniformly increased the degree of worry. The mean difference of worry between low and high self-efficacy was 2.19 (CI: 1.90–2.47) when the way was easy and 2.24 (CI: 1.96–2.52) when the climb was difficult.

4. Discussion

4.1. Summary of the findings

The purpose of this study was to ascertain how mountain climbers integrated certain variables (i.e., difficulty, meteorological conditions, carrying the appropriate tools, and confidence) in order to establish risk level judgments.

As highlighted by previous reports (Chamarro & Fernández-Castro, 2009; Chamarro et al., 2010), all four of the factors considered in the present study were highly relevant for determining risk perception in alpine climbing. In fact, the significance of the main effects indicated that the different levels designed for each variable gave rise to differing degrees of perceived risk (i.e., the risk is highest when the difficulty is high, the weather is bad, the athletes don't have the appropriate tools, and in situations of low confidence). In fact, variable risk evaluation outcomes appeared to validate the differential scenarios that were considered (Anderson, 1996).

In addition, the interaction pattern between selected variables is important. According to our results, when confidence is low, meteorological conditions and carrying tools contribute equally to an increased perception of risk. In contrast, when confidence is high, perceived risk is particularly low when climbers carry appropriate tools and meteorological conditions are good (i.e., the most favorable situation). In this scenario, confidence seems to play an over-protective role contributing to the minimization of risk perception, which can be dangerous because even safe situations can present natural hazards. Thus, this suggests that climbers may be unable to perceive risk in the absence of obvious indicators of difficulty or meteorological change. In these situations of low perceived risk and high confidence, climbers could make decisions without considering alternative options. For instance, alpine climbers might decide to engage in a difficult exposed ascent without considering escape routes if bad weather appears. Nevertheless, these results confirm our first hypothesis by highlighting the interactive relationship between meteorological conditions, carrying appropriate tools, and confidence.

Since a multiplicative relationship was observed between meteorological conditions, carrying the appropriate tools and difficulty, the second hypothesis was rejected. Generally speaking, perceived risk rises according to the severity of the meteorological conditions or not carrying suitable tools, but when the difficulty is high, the levels of perceived risk are maximal. So, when one of these conditions increases its severity, deterioration of the other is perceived more, which exponentially augments the level of worry. However, this relationship does not operate when confidence interacts with difficulty. This non-multiplicative pattern seems to confirm the minimization effect that confidence has over the negative effects of environmental variables. Similarly, confidence also reduces the effects of difficult or exposed climbing. Thus, even though confidence can allow climbers to cope with challenging or hazardous environmental conditions, it has a differential role in triggering perceived risk.

This kind of relationship between personal and environmental variables has been proven in studies of similar activities, including hiking (Chamarro et al., 2010), backcountry skiing (Chamarro et al., 2013), and preventive health behaviors (Edo et al., 2012; Frilieux et al., 2004). When the strain of a situation is high (e.g., a difficult climb with adverse meteorological conditions), the level of risk perceived largely depends on personal confidence. Thus, a climber's ability to cope with difficulties, tool limitations and/or environmental conditions may be considered as evidence of what Guillet et al. (2002) called "psychological robustness". This seemed to be a critical ability that was presented by our highly skilled sample. However, as discussed earlier, this effect may be dangerous if climbers don't simultaneously apply protective and security rules. In contrast to less hazardous situations (e.g., backcountry skiing), the multiplicative pattern between meteorological conditions and carrying the appropriate tools and difficulty suggests that environmental conditions, difficulty and progression/security tools may not be "substitutable entities" in alpine climbing. It is possible that this reduction in the information used for judgments might explain why trained backcountry skiers use heuristics (McCammon, 2004). On the other hand, in alpine climbing, rule-based, deliberate judgments appear to be necessary for coping with the complex demands of the activity. Additionally, in mountaineering, simplified judgments may have more serious consequences when compared to backcountry skiing. Nevertheless, when situational demands are not challenging, trained skiers or alpine climbers may use simple judgments. Therefore, they might only employ rule-based judgments when demands are high.

4.2. Limitations

This study presented some limitations. Given that the sample was made up of only selected, highly-skilled alpine climbers, these results may need to be replicated in other groups practicing hazardous sports. Indeed, the technical requirements and environmental restrictions of mountaineering could influence the way that these individuals appraise and integrate information. Another limitation relates to the broad range of age displayed by the study participants. Thus, future studies may need to verify our results in selected samples of mountain athletes.

4.3. Implications and conclusions

In conclusion, our findings have demonstrated how mountain athletes, who are exposed to hazards, cognitively appraise risk. Our evaluation of these individuals involved the analysis of variables that represent different components of the athlete–activity–environment interaction, highlighting how these factors are integrated into risk-related decision-making processes. Therefore, the differential combination of available information to make risk judgments is suggestive that mountain athletes are able to implement complex cognitive skills when making risk appraisals. Indeed, this is necessary due to the complex and demanding environment of the mountains. Their cognitive appraisal can be based upon different rules, depending of the requirements of the activity. Thus, those who practice the most risky sports, use the most complex rules. From our viewpoint, these results indicate that an alternative to simple heuristic processing is used when athletes must deal with risky situations (i.e., they switch to a "deliberate" judgment state). For this reason, the study of risk perceptions and decision-making is a promising tool for enhancing the safety of extreme sports.

From an educative and preventive standpoint, when the activity implies a risk of serious injury, it is important not only to train athletes in the necessary technical abilities, but also to sufficiently develop confidence. However, we must keep in mind that confidence can also contribute to the minimization of risk perception. Cazenave, Scanff, and Woodman (2007) referred to this ability as “self-awareness” in relation to the environment. If such judgments and decisions could be identified, then they could be used as basic algorithms for educational courses on decision-making processes. Also, alpine climbers could be trained how to use deliberate rule-based risk appraisal when dealing with risky situations. For instance, methods could be developed to help climbers recognize when they are behaving in a heuristic-based manner. As a consequence, they could learn to deliberately change to a rule-based way of thinking to maximize security and performance. As Chamarro & Fernandez-Castro (2009) have proposed, this could be facilitated by applying basic safety algorithms. In this regard, implementing fundamental rules to follow in complex situations, which require risk evaluation and decision-making, might lead to a drop in the perceived risk during ascents, a greater security, and better performance.

Importantly, our present findings can contribute to such approaches. In this respect, not only the environment–sport interaction must be considered, but also information related to the athlete's personal resources, especially confidence. Nevertheless, the manner by which mountain athletes create deep confidence to cope with hard climbing conditions is still not well understood. Thus, future studies should explore the foundations of this basic personal resource for alpine climbers and extreme athletes.

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Table 1. Analysis of variance for the repeated measures in the 2x2x2x2 design (difficulty, meteorological conditions, carrying the appropriate tools, and confidence) for determining the perceived level of worry.

Source	*df*	*F*
Difficulty	1	306.67**
Difficulty within-group error	133	(6.13)
Meteorological conditions	1	240.24**
Meteorological conditions within-group error	133	(5.39)
Carrying the appropriate tools	1	322.40**
Carrying the appropriate tools within-group error	133	(5.64)
Confidence	1	302.38**
Confidence within-group error	133	(8.68)
Difficulty by Meteorological conditions	1	12.57*
Difficulty by Meteorological conditions within-group error	133	(2.51)
Difficulty by Carrying the appropriate tools	1	13.10*
Difficulty by Carrying the appropriate tools within-group error	133	(2.12)
Difficulty by Confidence	1	0.19
Difficulty by Confidence within-group error	133	(2.25)
Meteorological conditions by Carrying the appropriate tools	1	9.59*
Meteorological conditions by Carrying the appropriate tools within-group error	133	(2.57)
Meteorological conditions by Confidence	1	13.97**
Meteorological conditions by Confidence within-group error	133	(2.40)
Carrying the appropriate tools by Confidence	1	9.41*
Carrying the appropriate tools by Confidence within-group error	133	(2.58)
Difficulty by Meteorological conditions by Carrying the appropriate tools	1	0.061
Difficulty by Meteorological conditions by Carrying the appropriate tools within-group error	133	(1.95)
Difficulty by Meteorological conditions by Confidence	1	2.05
Difficulty by Meteorological conditions by Confidence within-group error	133	(1.69)
Difficulty by Carrying the appropriate tools by Confidence	1	1.30
Difficulty by Carrying the appropriate tools by Confidence within-group error	133	(1.96)
Meteorological conditions by Carrying the appropriate tools by Confidence	1	8.09*
Meteorological conditions by Carrying the appropriate tools by Confidence within-group error	133	(2.22)
Difficulty by Meteorological conditions by Carrying the appropriate tools by Confidence	1	0.60
Difficulty by Meteorological conditions by Carrying the appropriate tools by Confidence within-group error	133	(1.95)

Note: values enclosed in parentheses represent mean square errors. * $p < 0.05$; ** $p < 0.001$.

Figure 1. Estimated levels of worry as a function of difficulty, meteorological conditions, carrying the appropriate tools, and confidence.

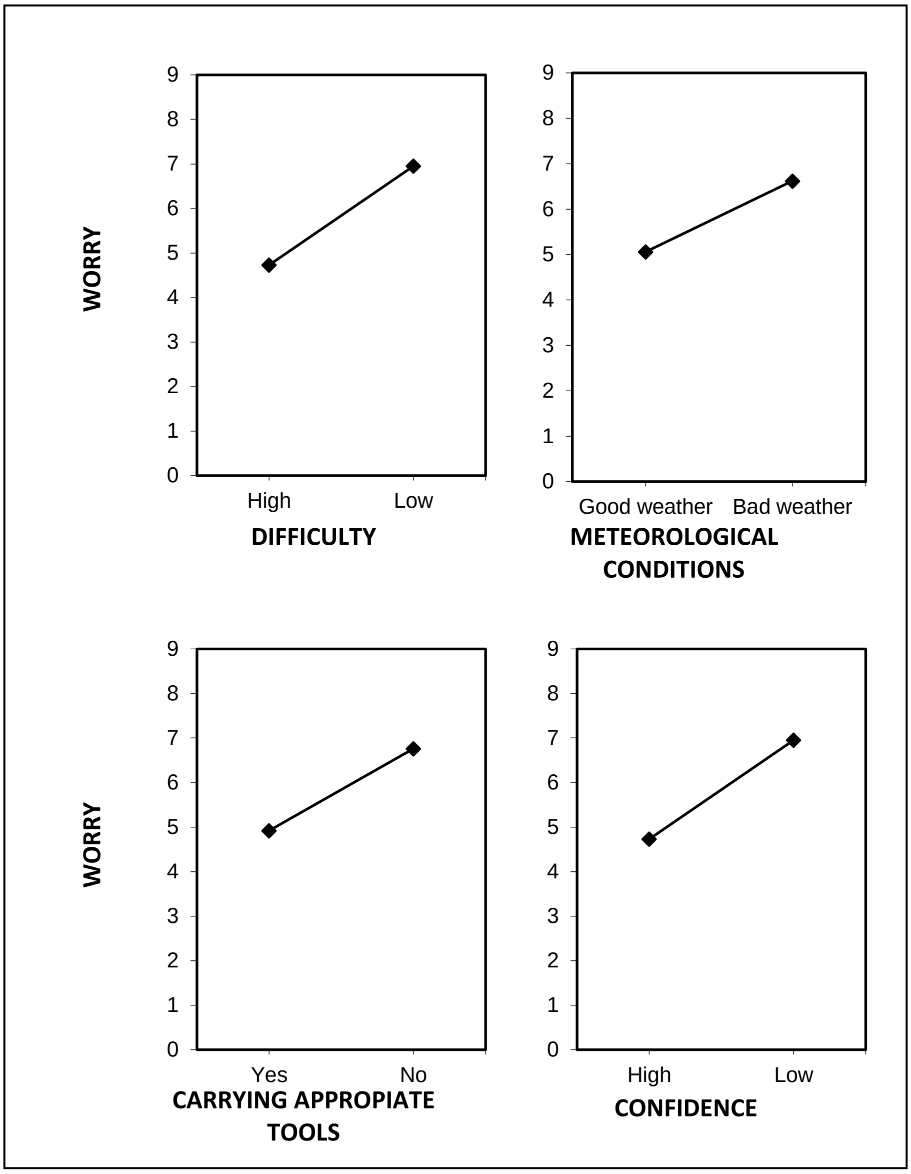

Figure 2. Estimated levels of worry as a function of meteorological conditions and carrying the appropriate tools, for high confidence (left) and low confidence (right).

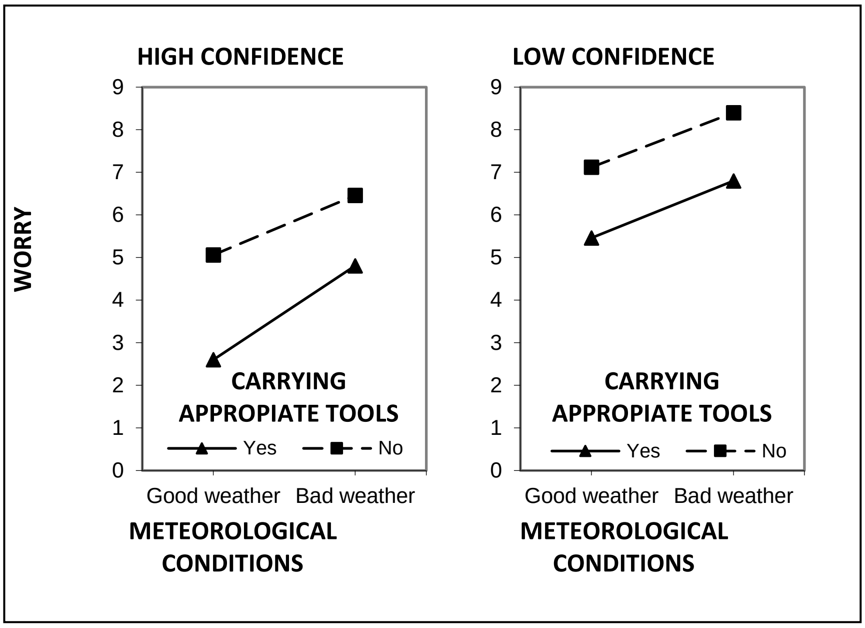

Figure 3. Estimated levels of worry as a function of difficulty and meteorological conditions (left), difficulty and carrying the appropriate tools (center), and difficulty and confidence (right).