Mapping Risk Judgment and Risk Taking in Mountain Hiking: An Information Integration Approach

Eric Fruchart, Patricia Paques Rulence

Mapping Risk Judgment and Risk Taking in Mountain Hiking: An Information Integration Approach

Eric Fruchart[1] & Patricia Rulence-Pâques[2]

University of Perpignan Via Domitia[1], France

University of Lille III[2], France

Corresponding author:

Eric Fruchart is a lecturer in psychology, director of LIPSEM.

Laboratoire Interdisciplinaire Performance Santé Environnement de Montagne – Research Unity 4604, Via Domitia Perpignan University, F-66120 Font-Romeu, France

Email: eric.fruchart@univ-perp.fr Phone : +33616990280

Rulence-Pâques Patricia is a lecturer in psychology.

Laboratoire PSITEC - Psychologie : Temps, Interactions, Emotions, Cognition. Axe 2 : Education et Société - EA 4072, Université de Lille III, Domaine du Pont de bois BP 60149 F-59653 Villeneuve d'Ascq, France.

Email: rulence@univ-littoral.fr

Mapping Risk Judgment and Risk Taking in Mountain Hiking: An Information Integration Approach

Abstract

Risk analysis is essential for promoting hiking-based tourism and for reducing the number of accidents. The objective of the present study was to map positions on risk judgment and risk taking, according to how 395 participants integrated three antecedents of the confidence frame (environment, team, and self). The participants filled out a questionnaire on risk judgment and another on risk taking. Each questionnaire was composed of eight scenarios that combined the three antecedents as information cues. A cluster analysis, repeated-measures analyses of variance, chi-square tests, and bivariate correlation analyses were applied to the questionnaire results. Three positions on risk were identified. The clusters' composition was related to the members' gender. A better understanding of information integration approaches may be useful for mountain hiking participants' safety.

Keywords: mapping, risk, information integration, confidence frame, mountain hiking

Mapping Risk Judgment and Risk Taking in Mountain Hiking: An Information Integration Approach

Mountain hiking has become increasingly popular over the last several decades in France. This activity is defined as hiking on official trails, non-official trails, small paths or terrain in a mountainous area (Zürcher et al., 2020). This type of outdoor activity in the mountains provides psychological and physical health benefits but also exposes participants to a risk of injury (Kortenkamp et al., 2017). The issue of safety is central in this mountain activity (Vanpoulle et al., 2017). Understanding the issue of risk is essential for reducing the number of accidents and for promoting hiking-based tourism (She et al., 2019). With this objective, we sought to map how individuals mentally integrate various information cues when judging risk situations in mountain hiking and when deciding whether to risk engaging in this activity.

To investigate the issue of risk, researchers in psychology have looked at the relationship between risk judgment (i.e. risk perception) and risk taking (Mills et al., 2008). In various domains, individuals' risk judgments can be a key underlying factor in their risk-taking behaviour (Schürmann et al., 2019). A typical theoretical and empirical prediction is that risk judgment is inversely correlated with risk-taking behaviour: the greater the judged risk, the less likely people are to take it (Reyna & Farley, 2006). However, other studies have found that risk judgment and risk taking are not correlated (Brewer et al., 2007) or that risk judgment is positively correlated with risk taking (Reyna & Farley, 2006). In sports psychology, for instance, Kern et al. (2014) identified individual factors associated with risk judgment and risk taking among skateboarders. The researchers found that a higher level of judged risk is related to greater risk taking by skateboarders. The results of Kern et al.'s (2014) study could usefully be applied to other physical activities, in order to improve our knowledge of risk judgment and risk taking. These various findings showed that individuals

may think about risk in different ways. The differences in the relationship between risk judgment and risk taking are not clear, and we reasoned that it would be useful to apply novel scientific approaches to better understand and explain this relationship (Mullet et al., 2004).

One possible explanation for the contradictory results for the relationship between risk judgment and risk taking is the influence of individual factors (Mills et al., 2008). Inter-individual differences in risk components might be explained by the person's gender and level of experience. With regard to gender, risk-taking behaviour by recreational skiers and snowboarders is more prominent among males than among females (Willick et al., 2019). The opposite difference in risk judgment was found by Reniers et al. (2016), since because men judged behaviours to be less risky than women did. With regard to the level of experience, Kern et al. (2014) suggested that it influenced risk judgment: the level of experience among skateboarders was positively correlated with their risk taking. Experience pushes mountain hikers to engage in risk-taking (Kortenkamp et al., 2017). Gender and experience have been investigated with regard to either risk judgment or risk taking but not the risk judgment and risk taking at the same time. In various mountain sports and leisure activities, women judged activities to be riskier than men did, and non-experienced individuals judged activities to be riskier than experienced individuals did (Demirhan, 2005). She et al. (2019) found that females judged activities to be riskier than males did and that more experienced hikers judged activities to be riskier than less experienced hikers did. However, the influences of gender and experience on both risk dimensions (risk judgment and risk taking) in a given outdoor mountain activity have not previously been assessed in the same study.

A second possible explanation for the disparate findings on the relationship between risk judgment and risk taking relates to the methods used. Mullet et al. (2004) highlighted the limitations of correlational techniques for modelling of the two risk dimensions. Even though the identification of a correlation between risk judgment and risk taking was an effective tool,

it did not provide insights into the individuals' cognitive processes during the judgment of risk and risk taking (Mullet et al., 2004).

Cognitive processes can be probed by applying information integration theory (Anderson, 2008). This approach focuses on the way in which multiple stimuli are integrated into a judgment or a decision, i.e. how people combine various information cues and how people use cognitive algebra to process information in different situations. Cognitive algebra refers to the subjective values (or psychological considerations) that people give to stimuli.

These three rules can be additive, conjunctive or disjunctive, as illustrated by the following hypothetical situation. A person is presented with a set of four situations related to a mountain activity (defined by an individual's level of equipment and his/her level of competence) and then has to perceive the degree of risk. There are two levels of equipment (with or without appropriate equipment) and two levels of competence (low competence *vs* high competence). Once the levels of risk have been estimated, they are plotted as a factorial graph (see Figure 1). With an additive rule (Figure 1(a)), equipment and competence are given the same weight (i.e. the same importance): the two lines are parallel and rise from left to right. An analysis of variance (ANOVA) of the raw data would show that the equipment x competence interaction is not statistically significant. With a conjunctive rule (Figure 1(b)), the lines form a fan open to the right, and an ANOVA would show that the equipment x competence interaction is statistically significant. With a disjunctive rule (Figure 1(c)), the lines form a fan open to the left, and the ANOVA would again show that the equipment x competence interaction is statistically significant. With disjunctive or conjunctive rules, equipment respectively has more weight or less weight than competence.

This information integration approach has been already applied to various domains, such as health risks (Muñoz Sastre et al., 1999), mountain sport (Fruchart & Rulence-Pâques, 2019), and risks in mountain sport (Chamarro et al., 2019). Muñoz Sastre et al. (1999) studied

the manner in which smokers integrated their daily cigarette consumption and the cigarette's nicotine concentration, in order to understand the relationship between exposure and the judged risk of lung cancer. The researchers' main finding was that the judgment of the risk of cancer increased as the level of smoking increased. Fruchart and Rulence-Pâques (2019) investigated the way in which non-athletes, mountain athletes, and non-mountain athletes combined five informational cues (relatedness, autonomy, competence, risk taking, and weather conditions) when judging the degree of arousal and the degree of satisfaction experienced during mountain hiking. There were no differences between the three groups. In all three groups, the influence of relatedness and risk on the judgment of arousal differed from that on the judgment of satisfaction. Chamarro et al. (2019) looked at how climbers combined the available information on environmental conditions and personal resources when judging the risk to their safety. The researchers found that all the factors had a highly significant influence on risk judgment.

The information integration approach has also been used to map different judgment and decision positions in sport (e.g., Fruchart & Rulence-Pâques, 2020) and different views of risk in the health domain (e.g., Muñoz Marco et al., 2017). Fruchart and Rulence-Pâques (2020) mapped how adolescents, young adults, and middle-aged adults cognitively combined five elements when estimating the level of well-being in sport. The results showed that all five elements had a significant impact on the judgment of well-being. Two positions for the judgment of well-being were identified: both positions were characterized by different cognitive processes and different levels of judgment, and both were associated with the participants' age. Muñoz Marco et al. (2017) mapped the manner in which children and adolescents judged the risk of catching a disease from sick friends. They estimated the risk transmission in scenarios that were constituted from the type of contact, the type of disease, and the number of contacts. Six risk judgment positions were identified.

The present study used the same scientific perspective to examine risk judgment and risk taking. The objective was to map people's positions on mountain hiking according to these two risk dimensions (risk judgment and risk taking), by identifying the manner in which the people cognitively integrate various factors. We considered three factors described in the literature on risk in mountain sports and which correspond to antecedents of the confidence frame in this setting (Males et al., 2015).

During adventure sports or mountain activities, individuals may be aware of immediate danger and they may develop a confidence frame. The latter is a type of "psychological bubble" used to cope with risk or to enjoy the sports situation (e.g., Houge Mackenzie & Kerr, 2014). The confidence frame provides feelings of safety from risk and is often operationalized as an individual's confidence in his/her equipment, his/her knowledge and skills, and/or the knowledge and skills of other individuals with whom he/she performs the activity (Apter, 2001). The development of this confidence frame may generate different levels of risk in these activities (Kerr & Houge Mackenzie, 2012). Within a protective confidence frame, risk taking is experienced as exciting. Without a protective frame, people feel anxious and scared. Thus, Males, Kerr and Hudson (2015) proposed three antecedents of the confidence frame in the sports domain: self, team, and environment. Self may refer to previous experience and accomplishments in the activity considered. Team may concern the support provided by social relationships. Environment may reflect equipment that ensures a more favourable situation.

As mentioned above, the objective of the present study was to map positions on risk judgment and risk taking in mountain hiking by identifying the ways in which individuals cognitively combine the three antecedents of the confidence frame (environment, team, and self). We considered three hypotheses. The first was that several different positions on risk judgment and risk taking would be found (e.g., Fruchart & Rulence-Pâques, 2020).

Depending on the cluster, the participants would combine or integrate the three antecedents of the confidence frame in different ways, and risk judgment and risk taking would be differently correlated (Brewer et al., 2007). The second hypothesis was that the composition of clusters of individuals would be linked to the individuals' characteristics, i.e., how often they went mountain hiking, and their gender (e.g., Fruchart & Rulence-Pâques, 2019).

Method

Participants

The participants were 395 students attending a university in France. There were 220 males (M_{age} = 21.35, *SD* = 2.25) and 175 females (M_{age} = 21.86, *SD* = 3.04). Participation was voluntary and not remunerated. After having obtained the dean's agreement, the two investigators contacted students, explained the study's objectives and procedures, and invited them to participate. When a student agreed to participate, a study appointment was arranged. Each participant had to state the frequency with which he/she went hiking in the mountains (very rarely/sometimes/often).

Material

The material comprised two questionnaires (one on risk judgment and the other on risk taking). Each included a set of cards bearing a scenario, a question, and a rating scale. Each scenario was designed to have three within-subject factor: Environment (with vs. without appropriate equipment), Team (participation with inexperienced people vs. experienced people), and Self (No experience or knowledge vs. prior experience or knowledge). Hence, the 2 x 2 x 2 factorial design yielded 8 scenarios.

One typical scenario was as follows: "Jean Dubeut is on holiday in the mountains and is thinking about going for a mountain hike: this would involve more than 6 hours of walking, 1200 meters of climbing, steep slopes, sometimes loose terrain, and some narrow paths with a sheer drop on both sides. Jean is in good physical condition. He is not very well equipped for

this hike (no hiking boots, no hiking clothing, and no walking sticks). He will be hiking with people with experience of mountain hiking. Jean has already done difficult hikes in the mountains."

In the first questionnaire (risk judgment), the question below each scenario was: "If you were Jean Dubeut, how risky would you perceive the planned mountain hike to be?". Beneath each question was an 11-point response scale, with "Not at all risky" indicated on the left and "Extremely risky" indicated on the right. In the second questionnaire (risk taking), the question below each scenario was: "If you were Jean Dubeut, to what extent would you take the risk of going on the mountain hike?". Beneath each question was an 11-point response scale with "Not at all" indicated on the left and "Absolutely" indicated on the right.

Procedure

The study was performed in accordance with the university's ethical standards. After the study had been approved by the dean, participants were tested individually in a room at the university. In line with Anderson's method (Anderson, 2008), the study comprised a familiarization phase and an experimental phase. In the familiarization phase, the experimenter explained the procedure to each participant. The experimenter informed the participant that his/her task was to read scenarios on a person's planned mountain hike and then perceive the degree of risk (questionnaire 1) or willingness to take the risk of going on the planned hike (questionnaire 2). During this phase, each participant was presented with three scenarios chosen so that the participant was exposed to the full range of stimuli. The objective of this phase was to make each participant as familiar as possible with the material and procedure. At the end of this phase, the participants could review their three answers and change them if wished. In the second (experimental) phase, all eight factorial design scenarios were presented to the participants. In contrast to the familiarization phase, the participants were not allowed to review or change their answers. Half of the participants were presented

with the risk judgment questionnaire first and the risk-taking questionnaire second. The other half were presented with the questionnaires in the reverse order.

Data analysis

Each participant's rating from the experimental phase of each questionnaire was converted to a numerical value expressing the distance between the point checked by the participant on the response scale and the left anchor (i.e. the point of origin). These numerical values were then subjected to graphical and statistical analyses.

To test our first hypothesis, we used a two-step cluster analysis (hierarchical and then non-hierarchical cluster analysis) to obtain a robust solution (e.g., Martinent et al., 2013). Firstly, a hierarchical cluster analysis using Ward's linkage method with squared Euclidian distance measure was used to determine the number of clusters in the data from the agglomeration schedule coefficients and the dendrogram. A repeated-measure ANOVA with cluster membership as a between-subject factor, the three factors as independent variables, and estimated means as the dependent variables was performed to check whether the cluster solution was valid (Aldenderfer & Blashfield, 1984). Secondly, we performed a *k*-means non-hierarchical cluster analysis by specifying the cluster solution. This clustering approach has been used to map individual different positions in the process of judgment in sport (e.g., Fruchart et al., 2019).

Several separate repeated-measures ANOVAs were conducted on the data from each cluster. Chi-square tests were used to establish whether cluster groups were associated with participants' gender and/or their level of experience in mountain hiking. Lastly, bivariate correlations between the data from each risk judgment cluster and the data from each risk-taking cluster were computed using Pearson's r.

Results

Cluster analyses

The results of the hierarchical analysis suggested that a four-cluster solution (K = 4) was tenable. A *k*-means cluster analysis of a four-cluster solution was then conducted. The four-cluster solution was similar for the two stages of the cluster analysis.

A repeated measures ANOVA with a Cluster x Risk x Environment x Team x Self, 4 x 2 x 2 x 2 x 2 revealed that the subgroups of four-cluster solution were significantly different ($p < .05$) with regard to all four factors: risk, $F(3,391) = 253.72$, $p < .001$, $\eta^2_p = .66$; environment, $F(3,391) = 35.50$, $p < .001$, $\eta^2_p = .21$; team, $F(3,391)$ (= 79.74, p < .001, $\eta^2_p = .17$, and self, $F(3,391) = 34.71$, $p < .001$, $\eta^2_p = .21$. The independent variable cluster was significant, $F(3,391) = 28.43$, $p < .001$, $\eta^2_p = .18$. These results confirmed that a four-cluster solution was tenable.

Tukey's test revealed a significant difference ($p < .001$) between Cluster 1 ($M = 4.83$; $SD = 0.06$) and the three other clusters: Cluster 2 ($M = 5.68$; $SD = 0.13$), Cluster 3 ($M = 5.21$; $SD = 0.05$), and Cluster 4 ($M = 5.64$; $SD = 0.08$). It also showed significant differences between Cluster 3 and Cluster 2 and between Cluster 3 and Cluster 4. The difference between Cluster 2 and Cluster 4 was not significant ($p = .999$).

Repeated-measures ANOVAs and graphical analysis

Overall repeated-measures ANOVA

A first set of four repeated-measures ANOVAs (one for each cluster) was performed on the whole set of raw data. The design for each ANOVA was Risk x Environment x Team x Self, 2 x 2 x 2 x 2. The main results are summarized in Table 1 and the four clusters are depicted in Figure 2. The estimated mean ratings are on the y-axis. Each panel corresponds to one level of the Risk factor (risk judgment or risk taking). The two levels of the Self factor are on the x-axis. Each curve corresponds to one level of the Team factor.

For the 117 participants (30% of the total) composing Cluster 1, the mean risk judgment rating ($M = 4.64$, $SD = 0.21$) was slightly lower than the risk-taking rating ($M =$

5.00, *SD* = 0.19). In both panels of the Figure, the curves form a broad fan opening to the left - indicating that the participants in this cluster used a disjunctive rule for risk judgment and for risk taking.

For the 27 participants (7%) composing Cluster 2, the mean risk judgment rating (*M* = 5.52, *SD* = 0.69) and mean risk taking rating (*M* = 5.84, *SD* = 0.82) were not significatively different. The curves in the left panel (risk judgment) are parallel, indicating that the integration rule was additive. The curves in the right panel (risk taking) form a small fan opening to the left, indicating that the integration rule was disjunctive. Hence, the participants in Cluster 2 used an additive cognitive rule for risk judgment and a disjunctive cognitive rule for risk taking.

For the 179 participants (45%) comprising Cluster 3, the mean risk judgment rating (*M* = 6.17, *SD* = 0.14) was markedly higher than mean risk-taking rating (*M* = 4.25, *SD* = 0.19). In both panels, all the curves are parallel – indicating that the participants in Cluster 3 used an additive rule for both risk judgment and risk taking.

For the 72 participants (18%) composing Cluster 4, the mean risk judgment rating (*M* = 4.37, *SD* = 0.43) was markedly lower than mean risk-taking rating (*M* = 6.91, *SD* = 0.29). The curves in the left panel (risk judgment) are parallel, which indicates that the integration rule was additive. The curves in the right panel (risk taking) form a small fan open to the left, which indicates that the integration rule was disjunctive. As was seen in Cluster 2, the participants of Cluster 4 used an additive cognitive rule for risk judgment and a disjunctive cognitive rule for risk taking.

Risk judgment

A second set of four repeated-measures ANOVAs was conducted on the risk judgment data from each cluster (Table 2). The estimated mean risk judgment ratings for each variable and each cluster are shown in Table 3. All three factors were statistically significant ($p < .05$)

in each cluster. The Environment × Team × Self interaction was not significant in Cluster 1 ($F(1,116)= 0.56$, $p = .455$, $\eta^2_p = .00$), Cluster 2 ($F(1,26)= 0.01$, $p = .978$, $\eta^2_p = .00$) or Cluster 4 ($F(1,71)= 3.08$, $p = .083$, $\eta^2_p = .04$). In Cluster 3, however, the Environment × Team × Self interaction was statistically significant, $F(1,178)= 8.23$, $p < .005$, $\eta^2_p = .04$.

Risk taking

A third set of four repeated-measures ANOVAs was conducted on the risk taking data. The findings of the ANOVAs performed on each cluster are presented in Table 4. The three factors were all statistically significant ($p < .05$) in each cluster. Table 3 shows the estimated mean risk-taking rating for each variable in each cluster.

In Cluster 1, the Environment × Team × Self interaction was significant, $F(1,116)= 9.03$, $p < .003$, $\eta^2_p = .07$. The Environment × Team × Self interaction was not significant in Cluster 2 ($F(1,26)= 0.55$, $p < .465$, $\eta^2_p = .02$) or Cluster 3 ($F(1,178)= 2.87$, $p < .092$, $\eta^2_p = .02$). In Cluster 4, the Environment × Team × Self interaction was significant, $F(1,71)= 2.35$, $p < .001$, $\eta^2_p = .16$.

Correlation between risk judgment and risk taking

For each cluster, the correlation between the mean risk judgment rating and the mean risk-taking rating was computed. The threshold for statistical significance was set to $p < .05$. In Cluster 1, the risk judgment was significantly and inversely correlated with risk taking ($r = -.303$, $p < .001$). In Cluster 2, the risk judgment was not significantly correlated with risk taking ($r = -.349$, $p = .075$). In Cluster 3, the risk judgment was significantly and inversely correlated with risk taking ($r = -.292$, $p < .001$). In Cluster 4, the risk judgment was significantly and inversely related to risk taking ($r = -.594$, $p < .001$).

Chi-square test

Table 5 shows the composition of each cluster in terms of the participants' gender. The 2 (male/female) × 4 (cluster) Pearson's chi-square test was significant, $\chi^2(3) = 18.23$, p

<.001. The 3 (very rarely/sometimes/often) × 4 (cluster) Pearson's chi-square test was not significant, $\chi^2(6) = 8.14$, $p = 228$.

Discussion

The objective of the present study was to map various positions on risk judgment and risk taking according to how the participants integrated three antecedents of the confidence frame (environment, team, and self). We had three starting hypotheses. The first was that there were several different risk positions, i.e. different participants integrated the three factors in different ways (e.g., Fruchart & Rulence-Pâques, 2020). This hypothesis was confirmed because an analysis of the whole set of raw data from the two questionnaires revealed three positions about risk. The first position corresponded to Cluster 1, the second corresponded to Cluster 3, and the third position corresponded to Clusters 2 and 4. (2) The second hypothesis was that the clusters' composition would be linked to how often the participants went mountain hiking and to the participants' gender (e.g., Fruchart & Rulence-Pâques, 2019). This hypothesis was confirmed in part; gender (but not hiking frequency) was associated with the cluster composition.

Our findings confirmed that the relationship between risk judgment and risk taking is complex (Schürmann et al., 2019) for many reasons. Various factors (such as the antecedents of confidence frame) may impact people's connection with risk and may be cognitively combined by individuals when judging/taking risks. Some individual characteristics (such as gender) may influence the manner in which people integrate these factors for judging and taking risks. Our first overall analysis showed that the participants varied with regard to judging a risk and (hypothetically) taking a risk. The three different risk positions corresponded to (i) Cluster 1, (ii) Clusters 2 and 4, and (iii) Cluster 3.

Risk position 1 (Cluster 1): use of a disjunctive rule

For the first risk position, people used the same disjunctive integration rule for both

risk judgment and risk taking. The risk judgment level was slightly lower than the risk-taking level. This position was more frequently endorsed by males than by females. This is consistent with the literature data in which males perceive activities to be less risky and are more likely to take risks than do females (Reniers et al., 2016; She et al., 2019; Willick et al., 2019). The lower the judged risk, the more likely the people were to take it. This position confirms the negative correlation between risk judgment and risk taking (Reyna & Farley, 2006).

Risk position 2 (Clusters 2 and 4): use of an additive rule for risk judgment and a disjunctive rule for risk taking

In the second risk position (Clusters 2 and 4), the rule used for risk judgment (additive) differed from the rule used for risk taking (disjunctive). The members of Cluster 2 judged mountain hiking to be sometimes risky and sometimes took risks. As suggested by Brewer et al. (2007), risk judgment was not linked to risk taking. The position in Cluster 2 was more frequently endorsed by males than by females. This result extents previous findings of gender differences in risk judgment and risk taking (e.g., Reniers et al., 2016; Willick et al., 2019), by stipulating the absence of a link between risk judgment and risk taking among males.

For the members of Cluster 4, the risk judgment level was clearly lower than the risk-taking level. The less the estimated risk, the more likely they were to take it. This position confirms the negative correlation between risk judgment and risk taking (Reyna & Farley, 2006). However, this correlation was stronger in this second position than in the first position. The position in Cluster 4 was more frequently endorsed by males than by females, confirming that males had judged a low level of risk and therefore took risks more readily (e.g., Willick et al., 2019).

Risk position 3 (Cluster 3): the use of an additive rule

In the third risk position, people used the same (additive) integration rule for risk judgment and for risk taking. The members of this position judged mountain hiking to be very risky and so did not wish to risk engaging in this activity. We observed that the higher the estimated risk, the less likely people were to take it. This position was more frequently endorsed by females than males, confirming that females perceive the mountains to be more risky and take less risks than males do (Reniers et al., 2016; Willick et al., 2019)

The relationship between risk judgment and risk taking

Our results highlighted the existence of two different relationships between risk judgment and risk taking: negative relationship and the lack of a relationship (Brewer et al., 2007; Mills et al., 2008; Reyna & Farley, 2006). The positive relationship found among skateboarders was not identified in the present study (Kern et al., 2014). In Kern et al.'s (2014) study, a higher level of judged risk was correlated with greater risk taking. This might be because we studied adults and Kern et al. studied adolescents. Adolescents' and adults' views of risk may differ (Frühauf et al., 2020). Our study found a negative relationship between risk judgment and risk taking. Three types of negative relationship were identified: (i) low risk judgment scores and high risk-taking scores (mainly concerning male participants), (ii) high risk judgment scores and low risk-taking scores (mainly concerning female participants), and (iii) intermediate risk judgment scores and slightly higher risk taking scores (mainly concerning male participants).

Although our results highlighted differences in ways of thinking about risk, one finding was consistent in all risk positions: the three antecedents of the confidence frame (i.e. self, team, and environment (Males et al., 2015)) had a negative influence on risk judgment and a positive influence on risk taking. Individuals considered mountain hiking to be riskier if they did not have appropriate equipment, if they were accompanied by inexperienced, non-competent people, and if they had no practical experience or knowledge. Conversely,

individuals considered taking more risks in the mountains if they had appropriate equipment, if they were accompanied by experienced, competent people, and if they had prior experience.

This finding confirms that people who participate in adventure activities may take risks when they develop a confidence frame (e.g., Houge Mackenzie & Kerr, 2014). Our observation of several different risk positions suggests that the emergence of a confidence frame produces different views of risk during mountain activities (Kerr & Houge Mackenzie, 2012). Our results extend earlier findings by emphasizing the different ways in which confidence frames are integrated into risk judgment and risk taking.

Our study has some limitations. Firstly, it was based on only three kinds of confidence frame antecedents (environment, team, or self); other factors should be investigated in the future (Males et al., 2015). Secondly, our three independent variables had only two modalities. In future research, all independent variables might include at least three modalities; this would facilitate identification of the cognitive rules used by the participants (Anderson, 2008). Thirdly, a third dependent variable could have usefully completed our experimental design. Just as information integration theory has been used to investigate the acceptability of an act in sport (Fruchart et al., 2019), the acceptability of risk could also be studied. Risk acceptability is essential for understanding the complex construction of risk taking (Tchiehe & Gauthier, 2017). Fourthly, given that adolescents and adults may differed in their approach to risk (Frühauf et al., 2020), further studies should map the cognitive processes involved in risk judgment and risk taking by adolescents.

Our present results might could have implications for training coaches or mountain guides. For example, stories dealing with problematic, potential risky situations (such as those in the present study) could be incorporated into briefings before a mountain hike. The hikers could compare their projected risk judgment and risk taking with those of coaches or mountain guides. The hikers' answers could be the starting point for training programs

designed to reduce risky behaviours or to increase hikers' levels of confidence. Thus, our results show that using a confidence frame decreases the judged risk and increases the likelihood of risk taking. Moreover, this view of risk prevention might help to distinguish between hikers as a function of their view of risk and therefore to offer them an appropriate activity.

References

Aldenderfer, M. S., & Blashfield, R. K. (1984). *Cluster analysis*. Sage Press.

Anderson, N. H. (2008). *Unified social cognition*. Psychology Press.

Apter, M. J. 2001. *Motivational styles in everyday life: A guide to reversal theory*. American Psychological Association.

Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*, *26*(2), 136–145. https://doi.org/10.1037/0278-6133.26.2.136

Chamarro, A., Rovira, T., Edo, S., & Fernandez-Castro, J. (2019). Risk Judgments in Climbers: The Role of Difficulty, Meteorological Conditions, Confidence and Appropriate Tools. *Leisure Sciences*, *41*(3), 221–235. https://doi.org/10.1080/01490400.2018.1442266

Demirhan, G. (2005). MOUNTAINEERS' RISK PERCEPTION IN OUTDOOR-ADVENTURE SPORTS: A STUDY OF SEX AND SPORTS EXPERIENCE. *Perceptual and Motor Skills*, *100*(3), 1155. https://doi.org/10.2466/PMS.100.3.1155-1160

Fruchard, E., & Rulence-Pâques, P. (2019). Arousal and Satisfaction during Mountain Rambling: Comparing Non-Athletes', Mountain Athletes' and Non-Mountain Athletes' Views. *Universitas Psychologica*, *18*(2), 1–5. https://doi.org/10.11144/Javeriana.upsy18-2.asdm

Fruchart, E., & Rulence-Pâques, P. (2020). Mapping judgment of well-being in sport. *International Journal of Sport and Exercise Psychology*, 1–16. https://doi.org/10.1080/1612197X.2020.1717577

Fruchart, E., Rulence-Pâques, P., & Mullet, E. (2019). Mapping adults' and young athletes' views regarding how acceptable it is to use a nutritional supplement in sport. *International Journal of Sport and Exercise Psychology*, *17*(5), 477–492. https://doi.org/10.1080/1612197X.2017.1367952

Frühauf, A., Zenzmaier, J., & Kopp, M. (2020). Does Age Matter? A Qualitative Comparison of Motives and Aspects of Risk in Adolescent and Adult Freeriders. *Journal of Sports Science and Medicine*, *19*, 112–120.

Hitchcock, J. L. (n.d.). *Gender Differences in Risk Perception: Broadening the Contexts*. 28.

Houge Mackenzie, S., & Kerr, J. H. (2014a). The psychological experience of river guiding: Exploring the protective frame and implications for guide well-being. *Journal of Sport & Tourism*, *19*(1), 5–27. https://doi.org/10.1080/14775085.2014.967796

Houge Mackenzie, S., & Kerr, J. H. (2014b). The psychological experience of river guiding: Exploring the protective frame and implications for guide well-being. *Journal of Sport & Tourism*, *19*(1), 5–27.

Kern, L., Geneau, A., Laforest, S., Dumas, A., Tremblay, B., Goulet, C., Lepage, S., & Barnett, T. A. (2014). Risk perception and risk-taking among skateboarders. *Safety Science*, *62*, 370–375. https://doi.org/10.1016/j.ssci.2013.08.009

Kerr, J. H., & Houge Mackenzie, S. (2012). Multiple motives for participating in adventure sports. *Psychology of Sport & Exercise*, *13*(5), 649–657.

Kortenkamp, K. V., Moore, C. F., Sheridan, D. P., & Ahrens, E. S. (2017). No Hiking Beyond this Point! Hiking Risk Prevention Recommendations in Peer-Reviewed Literature. *Journal of Outdoor Recreation and Tourism*, *20*, 67–76. https://doi.org/10.1016/j.jort.2017.10.002

Males, J. R., Kerr, J. H., & Hudson, J. (2015). Elaborating the Mastery State and the Confidence Frame. *Journal of Motivation, Emotion, and Personality: Reversal Theory Studies*, *4*. https://doi.org/10.12689/jmep.2015.405

Martinent, G., Nicolas, M., Gaudreau, P., & Campo, M. (2013). A Cluster Analysis of Affective States Before and During Competition. *Journal of Sport and Exercise Psychology*, *35*(6), 600–611. https://doi.org/10.1123/jsep.35.6.600

Mills, B., Reyna, V. F., & Estrada, S. (2008). Explaining Contradictory Relations Between Risk Perception and Risk Taking. *Psychological Science*, *19*(5), 429–433. https://doi.org/10.1111/j.1467-9280.2008.02104.x

Mullet, E., Ciutad, N., & Rivière-Shafighi, S. (2004). Cognitive processes involved in the assessment of health hazards' severity. *Health, Risk & Society*, *6*(3), 277–288. https://doi.org/10.1080/1369857042000275678

Muñoz Marco, V., Cano Martil, S., Munoz Sastre, M. T., Sorum, P. C., & Mullet, E. (2017). Mapping children's and adolescents' judgment rules for assessing the risk of disease transmission from sick friends: Contagion. *Infant and Child Development*, *26*(5), e2014. https://doi.org/10.1002/icd.2014

Muñoz Sastre, M. T., Mullet, E., & Sorum, P. C. (1999). Relationship between Cigarette Dose and Perceived Risk of Lung Cancer. *Preventive Medicine*, *28*(6), 566–571. https://doi.org/10.1006/pmed.1999.0482

Reniers, R. L. E. P., Murphy, L., Lin, A., Bartolomé, S. P., & Wood, S. J. (2016). Risk Perception and Risk-Taking Behaviour during Adolescence: The Influence of Personality and Gender. *PLOS ONE*, *11*(4), e0153842. https://doi.org/10.1371/journal.pone.0153842

Reyna, V. F., & Farley, F. (2006). Risk and Rationality in Adolescent Decision Making: Implications for Theory, Practice, and Public Policy. *Psychological Science in the Public Interest*, *7*(1), 1–44.

Schürmann, O., Frey, R., & Pleskac, T. J. (2019). Mapping risk perceptions in dynamic risk-taking environments. *Journal of Behavioral Decision Making*, *32*(1), 94–105. https://doi.org/10.1002/bdm.2098

She, S., Tian, Y., Lu, L., Eimontaite, I., Xie, T., & Sun, Y. (2019). An Exploration of Hiking Risk Perception: Dimensions and Antecedent Factors. *International Journal of Environmental Research and Public Health*, *16*(11), 1986. https://doi.org/10.3390/ijerph16111986

Tchiehe, D. N., & Gauthier, F. (2017). Classification of risk acceptability and risk tolerability factors in occupational health and safety. *Safety Science*, *92*, 138–147. https://doi.org/10.1016/j.ssci.2016.10.003

Vanpoulle, M., Vignac, E., & Soulé, B. (2017). Accidentology of mountain sports: An insight provided by the systemic modelling of accident and near-miss sequences. *Safety Science*, *99*, 36–44. https://doi.org/10.1016/j.ssci.2016.11.020

Willick, S. E., Wagner, G., Ericson, D., Josten, G., Teramoto, M., & Davis, J. (2019). Helmet Use and Risk-Taking Behavior Among Skiers and Snowboarders: *Clinical Journal of Sport Medicine*, *29*(4), 329–335. https://doi.org/10.1097/JSM.0000000000000527

Zürcher, S., Jackowski, C., & Schön, C. A. (2020). Circumstances and causes of death of hikers at different altitudes: A retrospective analysis of hiking fatalities from 2003–2018. *Forensic Science International*, *310*, 110252. https://doi.org/10.1016/j.forsciint.2020.110252