

## Original Article

### Development of a tool to analyze risk perception in Canyoning using a Delphi technique

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#### Abstract

**Background:** The demand for experiences in nature and adventure sport (NAS) is a growing reality and canyoning is one of the most indicative activities, since contemporary society seeks to acquire new skills and sensations. However, canyoning is considered a risk activity since the places are mostly accident/incident prone. The aim of this study was to develop a tool capable of analysing risk perception by those who practise canyoning.

**Methods:** Based on the literature we proceeded to identify the risks inherent in the practice of this activity. The environmental factors originate from the environment: the geomorphology, climatology and the fauna/flora. The human factors derive from Man's action via his operational, physical, emotional and cognitive skills

**Results:** After having identified these factors, the study developed using the Delphi technique, applying it to three rounds and integrating a panel of 60 specialists in this area. From the 96 initial propositions, 9 were excluded by consensus of the panel, while a total of 318 suggestions for improvement were presented. The third round ended with a total of 49 propositions, approved by 75% or more of the specialists for the final questionnaire.

**Conclusion:** Based on the specialists' opinion, a risk perception tool in canyoning was developed to acquire a notion of how risk is perceived by those practicing the activity. The information obtained from the answers to these questionnaires will be useful for the clubs/businesses that endeavour to improve their canyoners, bearing in mind the activity's safety and credibility.

**Keywords:** canyoning, risk perception, nature and adventure sport.

#### Introduction

Nature and Adventure Sport (NAS) is a physical activity which contributes to improvement in an individual's physical, technical and cognitive condition and overcoming the nature-based obstacles in the surroundings.

One of the realities that differentiates the NAS from the other activities is the deliberate search for the sensation of uncertainty in the final result, (1). According to Marinho & Inácio (2) the experiences felt in the NAS, before they take place, are always considered as something unachievable, always seeking for adventure, without ever knowing for sure the final result.

In this context, NAS is only attended by the most daring sportsmen wanting to experience extremes (3). However, in the last two decades, NAS has increased in popularity (4). People are more than ever seeking new sport experiences, going to green spaces in search of freedom, where there are fewer rules and limits (5). Presently, the majority of our population has already had some experience in NAS. After the first experience, continuity follows and there is a rise in the number of people practising this type of activity, both for recreation and sport (2).

NAS occupies and explores places in nature, water, on land and in the air, with different activities such as canoeing, rafting, canyoning, surf, mountaineering, climbing, hang gliding, paragliding and many others. With regards to canyoning, this is an activity that consists of controlled progression on a river/stream bed, mainly overcoming vertical obstacles, using a variety of techniques and appropriate equipment for its practice (4,6). Hiking, swimming, jumping are all ways of progression in rough terrain and canyoners should constantly assess and be aware of the risk they are exposed to and if they are willing to run it.

When we mention risk we refer to deliberate dangers in terms of future possibilities (7). So, the concept of risk is inseparable from the ideas of probability and uncertainty (8), this means, we cannot say that one is being confronted with a risk if the result of the action is already guaranteed. The risk concept shall be limited according to the manner in which it is perceived individually and, when taken voluntarily, since it is a component of canyoning (9).

Some authors refer to risk factors, dividing them into environmental and human factors (10–13). The environmental factors originate from the environment such as, the geomorphology, climatology and the fauna/flora. The human factors derive from Man's action via his operational, physical, emotional and cognitive skills. All the accidents in NAS occur when these combine or interact simultaneously, creating in this manner a potential situation for an accident.

It is evident that putting oneself in a risk situation is somewhat worrying for those who practise the activity. Therefore, it is essential that they have the required skills and master the specific and complex techniques to guarantee maximum safety and the smallest margin of error. In this line, training for risk perception by canyoneers and technicians is very important and should be taken into account at all times.

The lack of research in this area encouraged us to search for answers in order to help understand better how canyoneers see the risk they are exposed to and, consequently, improve some views. The aim of this study was also to describe the development of a tool for risk perception in canyoning for Portuguese and Spanish people who practise it.

### **Methodology**

The process for developing the questionnaire for risk perception in canyoning was done from October 2014 to February 2016, based on a review of literature, with research in SPORTDiscus (1960-2015), B-on (1960-2015), ScienceDirect (1960-2015), PUBMED (1960-2015), Academic Google and literature in the specific area, key-words: canyoning, risks, risk perception, mountain dangers, NAS, mountain sport; and with the support of the Delphi methodology.

As canyoning is a recent sport, the authors suggested the development of a questionnaire to perceive the risk factors for the Portuguese and Spanish who practise the activity and, therefore, obtain a more wide-ranging study.

This questionnaire was drawn up by Portuguese and Spanish canyoneers, members of the intervention and/or rescue groups and academics concerned with the methodology used for the translation proposed by Foddy, Quaresma and Vallerand (14–16).

Bearing this in mind, for the translation of the questionnaire of the 1st Delphi round from Portuguese to Spanish, two specialist teams were grouped. Each one consisted of two members fluent in Spanish, graduates in the Spanish language and with professional experience in translation. They were given a sample of the original version of the 1st Delphi round. The two versions resulting from each tool were subject to analysis by a group constituted by: a specialist in Spanish with professional experience in translation; two specialists in the field of canyoning; and by a specialist in the area of Sports Science. After putting together the opinions on the respective alterations, the final version was drawn up. The latter was then submitted to a new jury constituted by two specialists, one in Sports Science and the other in canyoning (15,17). This translation process was reproduced for the two following rounds of the Delphi model.

The Delphi technique is a model that was developed mainly by Dalkey & Helmer (18) in the 50s. It is now vastly used and considered a sufficiently strong technique to achieve consensus of opinions about a specific theme in certain areas, based on the opinion of specialists (19).

This technique has been used to clarify a number of problems in different sectors. In spite of having undergone some alterations, it continues to be a reliable approach for gathering opinions of specialists by means of an interactive structured process, contributing to that consensus (20,21).

This process involves multiple interactions with specialists, even when the latter are in geographically dispersed locations, since communication is possible by email (22), as was the case with the use of the Survey Monkey platform.

The Delphi methodology offers a wide range of advantages and is particularly useful because it avoids some obstacles observed in other group discussions, such as interpersonal influence, time pressure and group debates. This is due to the fact that respondents do not know the other interviewees' identity, are free, without social restrictions and with enough time to answer (22,23). In each round, the respondents had a minimum of 10 days to ponder and be able to make their decisions.

In this case, the Delphi process was performed in three rounds but it can be carried out in more rounds if necessary (21,24,25). The main question the participants were asked was: which factors can be classified as risk factors when canyoning?

For this purpose, we developed an online questionnaire in the Survey Monkey platform, tested by 5 people who practise adventure sports, teachers of Portuguese and Spanish, for comments on its suitability and functionality. Adjustments were made to make the questionnaire's statements clearer and more pertinent for this study.

The sample and use of experts are considered vital for the quality of the results in this process. In the Delphi technique the sample does not use a random representation of the population, but rather a group of specialists in the researched area. Therefore, our concern was to include academic specialists involved in research in canyoning; members of intervention and/or rescue groups, with training in rope maneuvering, having performed and/or trained in environmental places where canyoning is practised; and finally those who have more than 10000 hours of practice/training in this activity and/or more than 8 years of canyoning (26,27).

Taking this into account, we considered having a heterogeneous panel, with the essential number of members according to the number of experts available. We believe we have a solid sample, adjusted to the reality of this activity, (28,29). 64 specialists were invited but only 60 agreed to participate in developing this questionnaire, 35 were Portuguese and 25 Spanish. They were grouped into 3 categories: canyoneers; intervention and/or rescue group, with firemen, civil defence, civil guards, protection and SOS intervention group, cave rescue group and mountain rescue team; and academic specialists related to risk and nature exploration. Accordingly, we guaranteed that our panel included experts and members that covered the whole range of opinions of those involved in canyoning (30).

In this round, the specialist had to classify his degree of agreement with regards to including/excluding the statements of the perception risk tool in canyoning, using the Likert scale from 1 to 8, with 1 being “ I completely disagree that it should be included” and 8 “ I completely agree that it should be included” (31). We agreed to include in the final questionnaire the propositions with 75% or more of score 7 and 8 in the Likert scale, attributed by the specialists. Those that had 75% or more of score 1 and 2 were automatically excluded (25,32,33).

The expert was able to add new propositions or reformulate the existing ones, which were presented in the following round. In the subsequent rounds, the propositions that did not achieve consensus from the specialists in the previous round were also included. The specialists classified the statements again and three rounds of surveys were carried out. After the performance of each round the specialists had access to the results. At the end of the third round, we gathered all the data collected in the three rounds, eliminated the entire data not achieving consensus and kept only the data with consensus to be presented to the panel of specialists. The data collected is anonymous and confidential, and only to be used in the scope of this research for statistical treatment.

## Results

Sixty-four specialists were invited but only sixty were available to participate in the development of this questionnaire, four were of the female gender and fifty-six of the male gender. These were grouped into three categories: canyoneers, (n=27, with a mean of 15.41 years in the area); intervention and/or rescue group, (n=22, with a mean of 11.14 years working in this area); and academic specialists (n=11, with a mean of 13.36 years working in this area). In the second round 1 male member dropped out from the intervention and/or rescue group.

The results of the three rounds (total number of items, items with consensus, items without consensus, items excluded by consensus and improvement suggestions) for the dimension environmental and human factors are presented in Table I.

Table I – Results of the three rounds according to the following criteria

	Environmental Factors	Human Factors	TOTAL	
<b>1st Round</b>	Number of items	25	71	96
	Items with consensus	4	9	13
	Items without consensus	21	62	83
	Items excluded by consensus	0	9	9
	Improvement suggestions	84	170	254
<b>2nd Round</b>	Number of items	26	61	87
	Items with consensus	4	24	28
	Items without consensus	22	37	59
	Improvement suggestions	14	34	48
<b>3rd Round</b>	Number of items	19	36	55
	Items with consensus	2	6	8
	Items without consensus	17	30	47
	Improvement suggestions	8	8	16

In the first round, out of the 96 propositions presented, the experts approved 13 and contributed with 254 suggestions for improvement. Some were identical from specialist to specialist. From these suggestions, 84 were in the area of the environmental factors and 170 in the area of the human factors. The proposed suggestions were related to the way in which the ideas were presented, with grammar and/or semantic alterations in all the items.

In this same round, 9 items were excluded by more than 75% of the specialists and all these items were related to the human factors.

Based on the results of the first round, 87 items were presented in the second round. All these alterations were suggested by the specialists. In the environmental factors, we verified that five items were introduced in relation to the results of the previous round, and in the human factors, two of the items were joined, to form only one item as suggested by one of the members of the specialist group. 28 items were approved from the items suggested, of which 4 were related to the environmental factors and 24 to the human factors. 32% of the propositions were approved and 48 suggestions for improvement were presented. Two of these resulted from joining items since they were related. The other suggestions were related to the clarity of the ideas presented. In this round no proposition was excluded, this means, that no item received 75% or more of scores 1 and 2 in the Likert scale. In the last round, in the 55 propositions indicated, the specialists reached consensus in eight of them, two were related to the environmental factors and six to the human factors. After the three rounds, the experts did not reach consensus regarding 47 items; 30 of them concerned human factors and the remaining items environmental factors.

After the three rounds, we gathered all the data and integrated the 49 propositions that reached consensus by the specialists in a questionnaire that evaluates Risk Perception in Canyoning (RPCanyoning).

## Discussion

The main objective of this study was to describe the development of a tool capable of analysing risk perception in canyoning.

Specific studies in this area were not found, even less studies that involved a vast and heterogeneous team of specialists. It was of our interest and predisposition to integrate the opinion of specialists in various areas, such as canyoning, intervention and/or rescue members and academic specialists in the area of risk in NAS. This group, constituted by 60 people, aimed at including in it all the members involved in canyoning, in a more active or theoretical way (29,30,32,33).

As this is a recent sport activity and, although there are some studies in the area of risk and perception about it (10,11,13), the literature in NAS is still scarce, mainly in such a specific sport as canyoning. No questionnaire or tool has as yet been developed to consider and identify the perception that canyoning have about the risks associated to the practice of this activity.

Out of the 60 members of the specialist team that participated in the Delphi process, 35 are Portuguese and 25 Spanish. This team participated actively in this study as can be seen by the number of suggestions, which totalled in the three rounds 318 suggestions. It can also be verified that only one member of this team abandoned the process in second round, justifying this due to lack of time to be able to correspond in an honest way. Therefore, there was a response rate over 98%.

First, it is relevant that we present the concept of "risk". This concept is inseparable from the ideas of probability and uncertainty (8), that means, we cannot say that we are facing a risk if the result of the action is already guaranteed. The concept shall be limited depending on how it is perceived individually and while it is taken voluntarily, since it is an integral part of this activity (9). According to Berghaenel (34), to mention "risk" is to talk about the possibility of a territory (river) and the people that participate in it (those who practice it), being affected by a natural phenomenon. This term risk is seen by some authors, as a physical and/or emotional trauma or loss of something, regarding something valuable to be preserved which could well be a human life. This relationship that exists between the environment (river) and the presence of those who practice the activity makes the risk exist. Boholm & Corvellec (35), reinforce the relationship between two objects: the risk object (river) and the object at risk (those who practice the activity). In this relationship it is taken into account that the risk object influences in some way the object at risk. This is an interpretive theory aiming at answering the issues observed in theory and in practice in order to understand why something is considered a risk.

With regards to the person who practises canyoning, we studied the risk which the subject exposes himself to, in other words, the environment. Similarly, the subject also has his own risks which can influence the final result. For this reason, we characterized the risk factors into two categories: environmental factors and human factors (10–12).

When observing the environmental factors proposed in the first round in relation to the human factors, we verified that 74% of these factors were human and only 26 % were environmental. This discrepancy has to do with the number of dangers inherent to the human beings, with the latter having more variables which are interconnected regarding technical, physical, emotional and cognitive capacities (10,36–39). Similarly, we verified that at the end of the three rounds the work group was able to present new items and these focus more on the human factors. The final result showed that 80% of the items were related to the human factors and only 20% to the environmental factors. In an indirect way, these results are confirmed by the project of the *Federação Aragonesa de Montañismo* (the Mountaineering Aragon Federation) that together with the Aragon Government and the Aragon Mountains Association implemented the project *Montaña Segura* (Safe Mountain). This project has been identifying and analysing that the accidents/incidents in canyoning were caused by taking inappropriate decisions, using inappropriate material, deficiencies in the use of the material and planning, in other words by human factors (11,40).

We verified that in the first round the consensus was low, indicated in only 14% of the items and 86% with no consensus. In this round we obtained 254 suggestions, with suggestions in all the propositions and in

several of them more than one suggestion. In the second round, already with the alterations, 32% of the propositions obtained consensus by 75% or more of the research team members. This result was a consequence, possibly, of the alterations made by those involved in the process. In the last round, we notice a decrease in the results again, with only 15% of the propositions being accepted by the specialist team members and very few improvement suggestions. These results indicated that we did not need to add anything more to the final list of propositions (25).

We verified that the most evident propositions that achieved consensus in the environmental factors dimension were: *“The occurrence of sudden climatic alterations in the mountains presupposes risks”* and *“It is essential to find information about the river/stream flow before starting the activity”* with an agreement value of 88.1% and 85%, respectively. Regarding the sudden atmospheric alterations, according to (38) it is clear that one should always consult the weather conditions and analyse all the information that acquired. However, even with the information we have currently in the weather forecast, as the name itself indicates, it is only a forecast, subject to an approximate error of 14% and there is not a 100% information reliability (41). So, the canyoner has to take into account where starting and which is the river/stream basin due to sudden increases in the flow. For a sudden flood to occur it does not necessarily have to be. Rainfall can be occurring upstream and an increase in the river flow occurs, dragging the riverbed (42).

Heavy rainfall in the mountain can, in less than an hour, make a river overflow onto its banks and taking everything it finds on its way in an uncontrolled way (36). The fluid that runs in the river does not only consist of water but also sediments. This fluid is denser, but not very significant in rivers with a small current. When sudden increases of the flow occur it drags along with it more sediment and the canyoners are exposed to a higher risk. When this happens, this fluid is called hyper concentrate and the river flow has a brownish colour, caused by the various types of sediment accumulated on the river banks that are dragged along. If there are hyper concentrate fluids it is difficult for canyoners to move due to a higher density and viscosity of the water (43).

The proposition concerning the importance of the search for information about the rivers/streams flow before starting the activity, was referred by the team of experts as of great importance since in the majority of the rivers, the speed is proportional to its slope, in other words, the bigger the slope, the greater the speed, as a general rule. There is only a difference when there are water falls as in this case the speed increases but between two waterfalls the fluid's speed drops in relation to the water fall (44).

With a vast practical experience in the area of canyoning, Ortega (43), explains that the flow makes canyoning more dangerous as an increase in the flow implies an increase in the speed and, after a certain depth, approximately 70% the height of our body, we realize that we cannot control our body or remain static. Therefore, it gets harder to control the situation and our progression in the environment becomes strongly limited and conditioned.

As the activity develops the canyoner has to be capable of “reading” what is happening to the water, its movements and anticipate what can happen in such a situation, mainly in places, such as is the case of the reception in the lagoons, at the end of the rappel or in the jumps and even in the small ones that at times conceal dangers. Thus, we recognize that the water or fluid that runs in the river/stream bed is a conditioning factor for canyoning and the canyoners should whenever possible stop, observe, anticipate the dangers and analyze the water movements, sharing and discussing it with the group. After this analysis it is possible to take a safer decision, benefiting from the morphological features of the river course.

With regards to the human factors dimension, we verified that the propositions with most consensuses by the expert team are related to anticipation. The proposition: *“The one canyoning should take to the activity a first aid kit”* had a 96.6% approval rating and the proposition *“The training of self-rescue skills is fundamental”* was approved by all the expert team members (100%). This last proposition takes us to the training part, so that one is more prepared for possible danger situations. Colvin (26) expresses that our daily actions are unconscious processes, based on automated habits which we acquired throughout our childhood and adolescence, so we do not have to think consciously of what we do in our the daily tasks. Damásio (45) maintained that acting in an “unconscious” (automatic) way makes our process of decision-taking quicker and more effective, leaving us more time and space to observe more complex situations in a more conscious way. Taking this into account, he reinforces the idea of training and the need for it, as was defended by the expert team, emphasizing the self-rescue aspect. In these concrete situations, when time is scarce for decision-taking and in most cases involves emotional pressure, the more automated we are efficient we are. Consequently, the importance in acquiring experience and knowledge about what we have to decide and how to react with the skills acquired during the training process (46,47).

Some of the propositions presented to the expert team were rejected by the majority of the participants. We consider it convenient to indicate the 3 items which had a higher failure percentage. Proposition 1 with 84.7% - *“A jump is only considered technical if it is over ten meters and the reception has only four meters in depth”*; proposition 2 with 86.4% - *“Training is not na added-value for those who have a lot of experience”*; proposition 3 with 88.1% - *“For someone experienced in canyoning there is no need to look for detailed information about the rivers/streams”*. Further to having identified these items, we analysed if they had suggestions and which suggestions were recommended. In the proposition referring to jumping, we realize its importance as jumping is mentioned as one of the greatest causes of accidents in canyoning (38,48) and with the

suggestions presented we divided this item into two, suggesting in the second round the following items: “*A jump above 10 meters entails risks*” and “*A technical jump has a very limiting reception, with added risks*”. These two new propositions were suggestions made by a member of the specialist team, who mentioned that there were two propositions in one alone, contributing to doubts. These two propositions achieved agreement in the second Delphi round, the first one with 84.7% and the second one with 81.4%.

In proposition 2, which states that training is relevant for people with experience was also reformulated according to the improvement suggestions and, it was accepted by the specialist team in the second round, with the proposition “*The lack of training of the participants increases the risks, whether they are beginners or experienced in the activity*”, with an agreement rate of 81.4%. Proposition 3, in spite of being reformulated, never showed an acceptance equal or above 75% by all the team members, and, therefore was not included throughout the three rounds.

The tool which resulted from this process provides the scientific community with knowledge on how the participants perceive risk in canyoning. The information obtained by the use of this questionnaire shall be useful to understand risk perception.

This is the first study to gather the opinion from specialists with the purpose of identifying risk factors within the field of canyoning. We made a point of forming a team to express both Portuguese and Spanish views in the 3 areas (canyoners, intervention and/or rescue group and academics) so that it can be applied to a wider range of canyoners belonging to both national and Spanish territory. Due to the heterogeneity of those involved and their vast experience acquired throughout the years, the panel members were capable of analysing a wide range of factors and present extensive comments and new ideas in each round. This allowed us to use their knowledge to make changes and present new propositions.

In spite of all this research, this study shows some limitations. Our results may not be interpreted as representing the view of all the specialists in the area of NAS, specifically in canyoning. If this same information is submitted to two or more different panels there is no guarantee that the results obtained will be the same. However, there are several studies that show that the results are reliable and trustworthy (19,30). It is also important to highlight that the tool that we developed may not generate consensus in all parts of the world. This study was only developed and validated for the Portuguese and Spanish population, with the knowledge that other risk factors may be relevant in other latitudes of the planet (49,50). Additional research is required to provide the viability analysis of such evaluation and to adapt and reproduce this tool for other circumstances.

## Conclusion

The Delphi process identified 49 risk propositions, considered essential to observe risk perception in canyoning. The questionnaire RPCanyoning (Risk Perception in Canyoning) is a tool with two areas: environmental factors consisting of 10 propositions and human factors which comprise 49 propositions.

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