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Continuing or withdrawing from endurance sport events under environmental uncertainty: athletes' decision-making

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ABSTRACT
This paper seeks to answer the question: what impacts athletes' decision-making to continue or withdraw from an endurance sport event under environmental uncertainty amid the rise of extreme weathers? Underpinned by prospect theory and the framework of risk information seeking, qualitative data were collected via 14 in-depth semi-structured interviews with amateur and professional athletes and coded using thematic analysis. Findings suggest that endurance sport athletes do consider withdrawal as an option before and during an event. The severity of weather and a lack of physical and psychological preparedness may lead to the decision of withdrawal. Additionally, different decisions can be made under an interplay between weather conditions and physical and psychological status. Event organisers, family, friends and fellow participants may also influence athletes' decision-making. Finally, based on personal goals set for an event, both risk-seeking (continue) and risk-aversion (discontinue) behaviours may occur when facing the same environmental uncertainty. The paper calls attention to protecting athletes' wellbeing by undertaking timely withdrawals under environmental uncertainty. By highlighting the vulnerability of endurance sport athletes to environmental uncertainty, this study encourages event organisers to evidence their ability to face environmental uncertainty and enhance/preserve their reputation in event risk management.

KEYWORDS
prospect theory; risk information seeking; self-efficacy; climate risk; extreme weather; climate change

1. Introduction

On 22 May 2021, a tragic incident happened during the Gansu ultramarathon event in China. Twenty-one experienced, professional runners lost their lives to hypothermia during the endurance race (The Guardian, 2021). In a short period of time, the weather deteriorated between the second and third checkpoints (about 15 miles into the route) and runners were pelted with hailstones and icy rain. The sudden change of weather and a sharp drop in temperature exposed the runners to a risky situation, which was worsened by the lack of precaution and responsiveness from the event organisers.

Tragic events like this are not new or restricted to China. In 2008, two runners died in similar circumstances during the Zugspitze Run in Germany (The Local, 2008). More

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recently, a runner died as he finished a half-marathon in the United States, allegedly due to a high temperature (US News, 2022). These unfortunate disasters gave rise to questions about the safety measures in endurance sport events but more importantly, begged answers for the questions – what could participants have done differently in responding to the environmental hazards during the race? Was withdrawal an option? If so, what factors can lead to or prevent such a decision? How can sport managers and event organisers be better prepared for ensuring the safety of athletes and participants for future endurance sport events?

Endurance events involve an increased risk of injuries (Lamont & Kennelly, 2018) and sudden death (Strimel & O'riordan, 2015). Such risk is potentially higher under extreme weather associated with climate change, as athletes are more often the victims of fatal heat stroke than of cardiac events during endurance sports competitions (Angelini, 2015). This is an important issue given the increased popularity of endurance sports (K. Park et al., 2022). To date, the literature on endurance sport has focussed on how to sustain and improve endurance sport athletes' performance, for example, from psychology perspective (Crust, 2007). It lacks consideration of the factors that may impact athletes' decisions to continue or discontinue their participation in an endurance sport event, especially under extreme weather conditions. This is a significant knowledge gap to address because athletes' decisions to withdraw in a timely manner – when faced with environmental uncertainty during an event – can save them from irreversible mental or physical trauma, or even death. Relatedly, studies examined athletes' decision of withdrawal from sport participation or competitions in the context of sporting career transitions (e.g., Andrijiw, 2020). However, this prior research seldom mentions or explores the decision of discontinuing a specific competition. We seek to fill this void by providing empirical evidence to call for the attention towards the decision of withdrawal in endurance sport events. This has important managerial implications. For example, if athletes have the tendency to continue their participation even though environmental conditions become too dangerous, then sport managers and event organisers are required to intervene and take appropriate measures (e.g., immediately suspending or cancelling the event) to prevent athletes from harming their health.

The aim of this paper is to examine the dynamic decision-making process of athletes who consider giving up their participation in an endurance sport event under environmental uncertainty. To this end, we address the following research question:

> What impacts athletes' decision-making to continue or withdraw from an endurance sport event under environmental uncertainty?

Answering this question requires an understanding of: (1) how individuals make decisions under time constraint, uncertainty, and risks, and what risk behaviours are manifested; and (2) what conditions or factors lead to such behaviours. Following a literature review on decision-making (e.g., D. Funk et al., 2016; Simon, 1955), we have identified prospect theory (Kahneman & Tversky, 1979) and the framework of risk information seeking (Kievik et al., 2012) as central theories for generating insights and underpinning our research. Our work adds novel insights to the literature on endurance sport (e.g., K. Park et al., 2022; Lamont & Kennelly, 2018). First, this work demonstrates the potential threat of the culture of pursuing excellence in endurance sport to athletes' health and wellbeing. The impact of socioeconomic factors on athlete wellbeing has been examined recently (Wicker et al., 2020). However, these factors do not cover the decision-making process leading to

continue or withdraw from an event. Second, our research contributes to prior work concerning sport participants' responses to climate change (e.g., Orr & Schneider, 2018; Wicker & Thormann, 2021) by illustrating the decision-making process of athletes under the risks from environmental uncertainties.[1] Third, it advances our understanding of athletes' dynamic decision-making process of withdrawal. Practically, our findings provide managerial implications for sport event organisers and participants, pertaining to event safety measures and risk-related decision-making.

2. Literature review and theoretical frameworks

2.1. Endurance sports

Endurance sports refer to exercises that require athletes to persevere in continuous, dynamic, and whole-body exercise tasks that are performed over middle or long distances (McCormick et al., 2019). Examples include marathon running, cross-country skiing, road cycling, open water swimming, mountain biking, horse riding, canoeing, and kayaking. Endurance sport events require participants to exert for more extended periods than in other sports because the distance and time are longer and the level of aerobic fitness or intensity required for successful completion is higher (Myburgh et al., 2018). Endurance sport participants are categorised into recreational and elite cohorts based on their purposes of participation (McCormick et al., 2019). The elite cohort includes athletes participating for competitive results, whereas the recreational cohort participates in endurance sports for more than sheer competitive purpose (e.g., pleasure, physical health; McCormick et al., 2019). Despite this distinction, both cohorts compete because they desire to manage the challenges an endurance sports event offers, which can happen at all performance levels, in line with the notion of "serious pursuiters" (Wicker et al., 2012, p. 1). Because the term "recreational" may not align with the idea of challenging oneself, we opt to use the term "amateur (athletes)" instead (Maxcy et al., 2019).

Hochstetler and Hopsicker (2012) argue that endurance sports are not merely a means for weight loss or an activity to endure, but rather an enterprise replete with challenge and freedom. They point out that participation in endurance sports is more a kind of spirituality accompanied with "a heightened sense of growth", "an increased ownership", and "a lifestyle" (Hochstetler & Hopsicker, 2012, p. 121). Endurance sport participants are often seen as a group of people, who obsessively spend time, energy and money dedicating themselves to their respective craft (D. C. Funk & Bruun, 2007; D. C. Funk et al., 2007; Maxcy et al., 2019; Wicker et al., 2013). Such dedication naturally leads to physical and psychological demands and risks for endurance sport participants.

2.2. Physical and psychological demands in endurance sport participation

Endurance sport athletes commonly encounter the following physical demands (Tuffey, 2000): (1) long and repetitive training sessions; (2) pain, discomfort, and fatigue during training and competitions; and (3) preparation for events, which

[1]For the sake of clarity, risk is defined as the situation under which the decision outcomes and their probabilities of occurrence are known or can be assessed to some extent by the decision-maker, while uncertainty is defined as the situation under which such information is not available to the decision-maker (K. F. Park & Shapira, 2017).

includes developing and committing to a racing plan to allow them to overcome pain and discomfort. Holt et al. (2014) found that physical stressors such as muscle pain, cramping, injuries, and dehydration have negatively affected ultramarathon runners' performances. This finding is in line with numerous studies revealing the physical demands in endurance sports, especially the exercise-related sensations, which make endurance sport participation an extreme physical duress (e.g., Bridel, 2013; Maxcy et al., 2019; McCormick et al., 2019).

Endurance sport participants also experience various psychological demands during training and events, such as high competitive anxiety, low or high emotional state, high levels of life changes, low coping resources, and low levels of social support (Cooper et al., 2020). Within specific endurance sports, antecedents and outcomes of psychological demands can vary. For instance, phrases such as "hitting the wall" used by marathon runners, and "bonking" reported by triathletes and cyclists (Buman et al., 2008) are referred to as the episodes of extreme fatigue and exhaustion, which lead to athletes' increased psychological stress.

In spite of the high demands and pressures, endurance performers are known for their strong will, advanced physical skills, and developed psychological coping mechanisms, which allow them to remain determined, focused, and in control under certain extreme conditions (Connaughton et al., 2008; Cooper et al., 2020). Several main coping mechanisms have been demonstrated by endurance sport participants in response to extreme physical and psychological challenges, such as self-regulation and mental toughness (e.g., Crust, 2007; Taylor et al., 2020). Self-regulation requires endurance sport athletes to distribute their available energy over the race in a way that they can find an optimal balance between stages (e.g., swimming, cycling, and running in Ironman competitions; Elferink-Gemser & Hettinga, 2017). Mental toughness refers to an important psychological element in overcoming physical fatigue and achieving endurance sport excellence (Connaughton et al., 2008). It represents a variety of positive responses to situations, such as the ability to persist and refuse to give up, overcome setbacks and poor performances, cope with excessive pressure, and push oneself to the limit during training and in real competitions (Cooper et al., 2020; Crust, 2007).

In addition, athletes' ability to resist feelings of discomfort and the urge to quit is seen as critical to ensure successful endurance performance (Taylor et al., 2020). For example, Howe (2004, p. 86) referred to the "burning ache all over the body during and after the [training] session" as "positive pain" – a type of bodily sensation that one must be willing to suffer for success. People tend to praise attributes such as perseverance and normalise the experiences of pain, injury or other types of risks in sport as the "culture" of sport (Bridel, 2013; Taylor et al., 2020; Theberge, 2008). Pain and other embodiments of suffering during the course of endurance sport events are internalised to be part of athletes' identity or sense of self (Bridel, 2013). Consequently, arduous physical challenges may not be perceived as a "stop" signal by athletes, and instead may be seen as an opportunity to flourish (Hochstetler & Hopsicker, 2012).

2.3. Climate change and environmental uncertainty: new risks in endurance sport participation

In normal circumstances, testing personal limits and willpower is an admirable action in sport. However, under extreme or hazardous environmental conditions, the much valued not-giving-up attitude or "culture" presents a potential threat to endurance sport participants' health (Theberge, 2008). The various coping mechanisms to endure physical and psychological constraints can also be a double-edged sword that lead to either better endurance performance, or making endurance participants more vulnerable to environment-associated risks (Angelini, 2015). As such, environmental uncertainty and risks can present new challenges to endurance sports participation.

Researchers have examined various types of climate change and their impact on sport event operations, such as extreme winds (Giddy, 2018), sea level rises (Kellison & Orr, 2021), heavier rainfall (Goggins et al., 2018), and warmer winter and associated impacts on winter sport events (Fairley et al., 2015). In addition, the recent decade has amplified the endurance sporting events' vulnerability under climate change. An example is the cancellation of the American Birkebeiner Challenge, North America's largest cross-country skiing event in 2017 due to warm weather. During the 2020 Tokyo Summer Olympics, both marathon and race-walking events had to be moved to a supposedly "cooler" site in Sapporo, due to the concerning heat and humidity experienced in Tokyo.

Given these impacts of climate change, understanding the decision-making process of individual athletes in facing environmental uncertainties is crucial for the efficient and safe hosting of endurance sport events and protecting the health and wellbeing of athletes. As sports continue to factor into governments' health promotion agenda and strategies, and the popularity of endurance sports participation continues to grow, there is an urgent need to address environmental uncertainty and risks associated with endurance sport events.

2.4. Theories of individual decision-making under risks

2.4.1. Prospect theory

Decision-making under risk is a process, involving evaluation and section of alternative goal-directed responses whose outcomes are uncertain (Schiebener et al., 2014). Prospect theory describes how individuals make choices under conditions of risk (Kahneman & Tversky, 1979). According to this theory, a decision-maker's risk attitude changes depending on whether a prospect is perceived as a gain or loss relative to a reference point or an aspiration level (Kahneman & Tversky, 1979). This theory also highlights that the reference point is subjective, and people tend to undervalue or overvalue losses relative to comparable gains, which leads to the behaviours of risk-seeking and risk (or loss) aversion. Risk-seeking behaviour is "an activity in which individuals engage, is perceived by them to be in some sense risky but is undertaken deliberately and from choice" (Tulloch & Lupton, 2003, p. 10). Risk-aversion, on the other hand, represents an "individual's degree of negative attitude towards risk arising from outcome uncertainty" (Mandrik & Bao, 2005, p. 533). For example, in a marathon event, a reference point can be a pre-determined goal (e.g., time/stage) for an athlete to evaluate their running performance (Allen et al., 2016).

By applying prospect theory to the behaviours of marathon participants, Markle et al. (2018) find that, if runners fall short of their athletic goals, they are likely to demonstrate risk-seeking behaviours, such as picking up the pace than they had planned to meet the goal. In contrast, if runners achieve their pre-determined time by a stage, or perform better than planned, they are likely to be satisfied with their performance and exhibit risk-aversion strategies, such as self-regulating or slowing down the pace to avoid early fatigue. Relatedly, Maxcy et al. (2019) examination of Ironman participants finds that frequent thoughts of giving up during the race reduce happiness after the race, while mental torture during training and race negatively affects happiness in the weeks after the race. The authors also find that satisfaction with race outcome positively affects happiness, suggesting that achieving individual goals is more important than absolute performance in terms of finishing times and ranks.

In our study, prospect theory serves as a useful tool to understand how endurance sport participants evaluate a risky situation, especially under environmental uncertainties, and make the decision to continue (risk-seeking) or discontinue (risk-aversion) their participation in an event. However, the theory fails to account for the factors that contribute to a decision-maker's risk-seeking or risk-aversion behaviours. Thus, we integrate prospect theory with the framework of risk information seeking (Kievik et al., 2012) to address this issue. Figure 1 provides an illustration of the theoretical integration within the context of this study.

2.4.2. The framework of risk information seeking

The framework of risk information seeking focuses on the central position of a risk information recipient in the risk communication process, identifying factors that may influence how individuals respond to risk information and explaining how these responses lead to individuals' behavioural adaptations to particular risky situations (Kievik et al., 2012). This framework proposes that individuals tend to seek risk information before making an important decision, such as whether to adapt their risk behaviours (e.g., risk-seeking or risk-aversion) (Ter Huurne & Gutteling, 2008). Three factors are outlined in

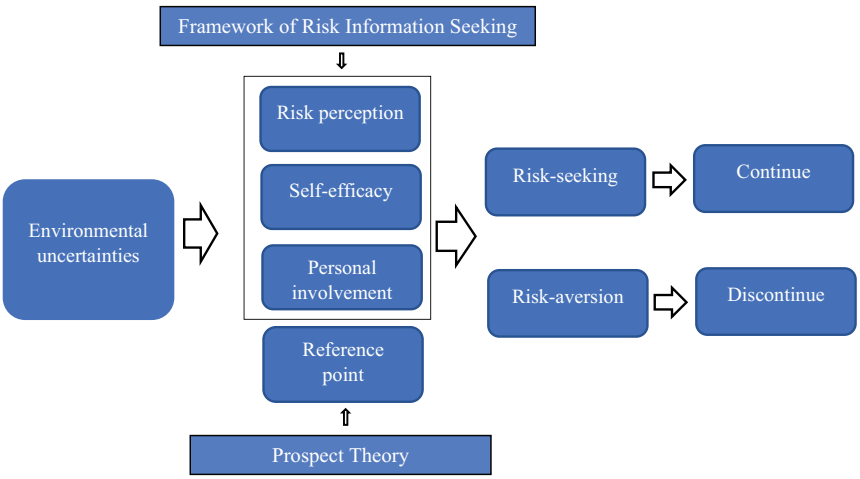

Figure 1. Individual decision-making process under environmental uncertainties.

the framework that play key roles in the process of risk assessment: risk perception, self-efficacy, and personal involvement.

Risk perception is a decision-maker's assessment of the risk inherent in a situation (Sitkin & Pablo, 1992). It is an individual's subjective judgement and intuitive perception of the outside, objective risks (Slovic, 1987). For example, people who have directly experienced severe weather or climate-related phenomena tend to perceive higher risks from climate change compared to people for whom the same phenomena are more psychologically distant (Spence et al., 2012). Risk perception can be influenced by various factors categorised into three domains: the characteristics of hazards (e.g., dread risk and unknown risk), the characteristics of risk perceivers (e.g., demographics, knowledge, value orientations, psychological traits and optimism bias), and heuristics that are applied to formulate risk perceptions (e.g., the availability heuristic, the affect heuristic, and the natural-is-better heuristic) (see Siegrist and Árvai (2020) for a detailed review of these three domains). Higher risk perception is assumed to reflect higher uncertainty, which in return affects consequent risk behaviour (Ter Huurne & Gutteling, 2008).

Self-efficacy refers to an individual's perceived ability to cope with risks adequately with the newly acquired information (Bandura, 2000). It can be seen as an important factor in how a decision-maker construes risks, and successively impact their risk responsive behaviours (Kievik et al., 2012). People with high efficacy are confident about their ability to enact a behaviour that will result in positive outcomes, and tend to motivate people to initiate challenging tasks and to persevere in the face of setbacks (Rimal & Real, 2003). Research suggests that there is a positive relationship between self-efficacy and performance in a variety of endurance sports (Anstiss et al., 2020). In addition, a runner who demonstrates high personal efficacy is more likely to exert personal control over a certain risk through tactics, such as enhanced training, information preparation, and risk coping strategies (Anstiss et al., 2020).

Personal involvement represents a person's interest in and commitment to a specific cause (Kievik et al., 2012). It is directly associated with a person's motivation to acquire risk-specific information on the basis of evaluating whether the situation or issue will have significant consequences to one's life (Ter Huurne & Gutteling, 2008). In general, in domains the individual cares little about, the behaviour is often a direct response to the situational constraints and not necessarily reflective of one's knowledge. However, in domains of high personal involvement, the person should be more motivated to act in accordance with the knowledge, experience, and internal values (Chaffee & Roser, 1986). Consequently, individuals with high involvement are likely to analyse issues more often and pay attention to persuasive information because of their perception that important future consequences are at stake. Both prospect theory and the framework of risk information seeking will jointly serve as a heuristic tool examining endurance athletes' decision-making process under environmental uncertainty.

3. Research method

3.1. Data collection and sampling

This study is guided by a critical realist ontology that views reality as both objective (e.g., natural environment such as weather is an uncontrollable element in endurance sport

events) and socially constructed (e.g., endurance sport participants adapt their strategies to compete safely) (Bhaskar, 2014). To understand the factors that affect endurance sport athletes' decision-making process to continue or discontinue participating in an event, qualitative data were collected using semi-structured interviews (Bryman, 2016). A purposive sampling strategy was used to identify and select participants based on their capacity to provide in-depth information related to the phenomenon of interest (Gentles et al., 2015). Specifically, participants were screened via two criteria: (a) they were involved in endurance sport participation for at least three years and (b) they have considered withdrawing or actually withdrawn from a competition due to environment-related risks. The research team was in a privileged position as the second author is an experienced Ironman contestant and an active participant within China and the UK endurance sport social worlds, which enabled a relatively smooth interviewee recruitment process. This also explained the interviewees' location as shown in Table 1. We sought 14 interviewees who were either professional, semi-professional, or amateur participants in distance running (e.g., marathon, ultramarathon), swimming, cycling and/or triathlon (including Ironman[2]). We terminated our data collection when data saturation was achieved (Guest et al., 2006), that is, similar information and comments were repeated by interviewees.

Nine male and five female athletes at the age group of 20s to 50s were invited to participate in the interviews. Athletes' participation length in endurance sports varied from 4 years to 18 years. Most interviewees have participated in more than one type of endurance sport and shared the experience of starting with one sport (usually running), then moved to two sports, and finally in triathlon (including Ironman) events. Table 1 provides an overview of interviewee profiles.

Table 1. Interviewee profiles.

Name	Gender	Location	Age	Experience (Years)	Endurance Sport(s)	Level
A	Male	China (Mainland)	35	12	cycling, ultramarathon, Ironman	Semi-professional
B	Male	China (Mainland)	35	6	marathon, Ironman	Amateur
C	Male	China (Mainland)	35	11	cycling, triathlon	Professional
D	Male	China (Mainland)	43	18	swimming, triathlon	Professional
E	Male	China (Hong Kong)	56	12	marathon, Ironman	Amateur
F	Male	China (Mainland)	28	7	marathon, triathlon	Amateur
G	Male	China (Mainland)	28	4	swimming, marathon, triathlon	Amateur
H	Female	United Kingdom	32	7	marathon, triathlon	Amateur
I	Female	China (Mainland)	41	13	marathon, triathlon, ironman	Amateur
J	Female	China (Mainland)	43	6	marathon, triathlon	Amateur
K	Female	China (Taiwan)	40	9	marathon, triathlon, ironman	Amateur
L	Female	United Kingdom	33	7	marathon, triathlon, ironman	Amateur
M	Male	United Kingdom	28	12	cycling, triathlon, ironman	Semi-professional
N	Male	United Kingdom	37	11	marathon	Amateur

[2]Ironman is one form of long-distance triathlon races organised by the World Triathlon Corporation, consisting of a 2.4-mile swim, a 112-mile bicycle ride and a marathon 26.22-mile run. It is considered one of the most difficult endurance sport events in the world.

Interviews initially sought to profile interviewees to confirm they were engaged in endurance sport by asking about the numbers and types of endurance sports they have participated in, length of involvement, and hours spent on training per week. Interviews then asked their perceptions of the culture of endurance sport and characteristics of endurance sport participants (including themselves and observation of others). This was to better contextualise the endurance sports community. Subsequently, participants were asked to reflect on their purposes and experiences of participating in endurance sport events. Particular attention was paid to asking about the environmental risks related decision-making, with sample questions including:

- What was the most unforgettable environmental risk that you have experienced during your endurance sport participation?
- Did you consider withdrawing from the event because of the environmental risk?
- How did you make the decision?
- What factors influenced your decision-making?
- How did you feel about the decision afterwards?
- Did you experience environmental risk at other times during your endurance sport participation and how did you react?

All interviews were conducted online using Microsoft Teams in July 2021, lasting from 45 to 90 minutes. Interviews were digitally recorded (with participants' approval) and subsequently transcribed. For non-English (i.e., Chinese) transcripts, the lead author, who is a native Chinese speaker, translated them into English, with the second author (another native Chinese speaker) double-checking for linguistic accuracy. A total of 240 pages of data transcripts were produced and imported to NVivo software for analysis.

3.2. Data analysis and trustworthiness

Thematic analysis was used to elicit emerging codes, themes, and sub-themes. Following Braun and Clarke (2006), the data were analysed in six phases: (1) getting familiar with the data; (2) generating initial codes; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes; and (6) writing the results. The authors repeatedly read the transcripts to familiarise with the data (Step 1). An initial coding framework was then generated by the end of Step 2. With guidance of this framework, data were then extracted and organised into themes (Step 3). Seven broad themes were first developed, which included "severity of weather", "physical conditions", "psychological conditions", "individual risk perception", "self-efficacy", "personal goal of participation", and "interpersonal influence from other people". Further, these themes were reviewed and grouped (Steps 4 and 5), which led to five final themes, as presented in Figure 2 (Step 6). The coding and analysis process was led by the lead author, who regularly met with the research team to compare, review, and refine the emergent themes. Differences in researchers' coding schemas were largely limited to semantics of various codes.

Trustworthiness of qualitative research is essential to mitigate potential bias (Bryman, 2016). We acknowledge the potential benefits of having one researcher as an "insider" in studying specialised populations (endurance sport athletes, in this case) with their capacity to provide deeper insights into the phenomenon of interest (Dwyer & Buckle, 2009).

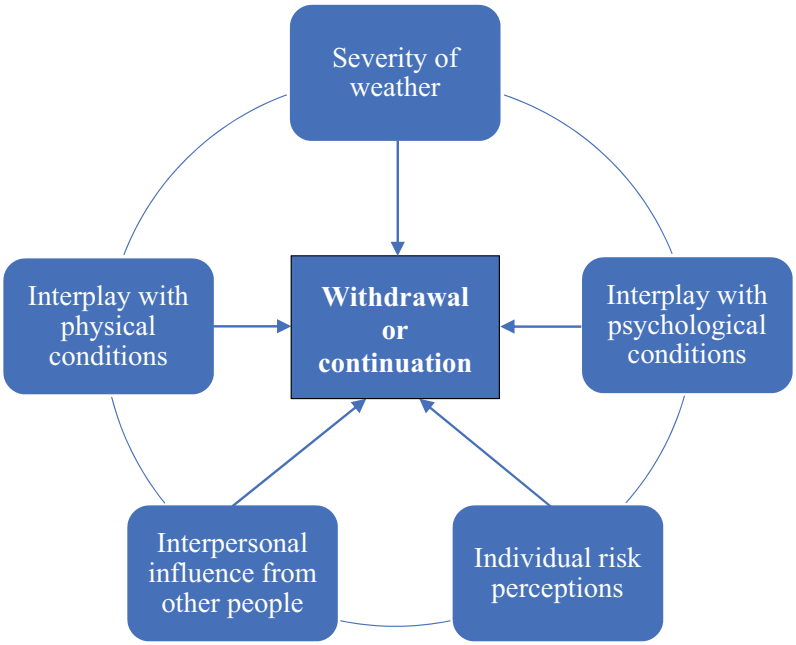

Figure 2. Factors affecting athletes' decision-making to withdraw or not from participating in endurance sport events under environmental uncertainty.

This has enhanced our ability to empathetically relate to our interviewees, leading to rich, authentic accounts of their perceptions and experiences. Nevertheless, we were aware of the potential bias brought by the "insider's" perspective (Dwyer & Buckle, 2009). Hence, the lead author led and undertook all interviews to avoid informants' personal attachment to the second author. Member checking of transcripts, codes and themes was undertaken to enhance trustworthiness (Bryman, 2016). Finally, to preserve participants' anonymity, the names of interviewees were substituted with pseudonyms (A, B, C . . . N).

4. Findings

The research question guiding this investigation was: What impacts athletes' decision-making to continue or withdraw from an endurance sport event under environmental uncertainty? Our analysis reveals that participants decide whether to continue or discontinue their participation in an event based on the influence of five main factors (see Figure 2).

4.1. Severity of weather

All participants highlighted the influence of weather conditions on their decision-making. That is, depending on the severity of the weather, participants choose whether to participate in an endurance sport event. For instance, Interviewee (M) pointed out that he did not like to race in a heavy rain, particularly for the cycling event:

> Light rain is okay, but heavy rain which lasts more than 30 mins to an hour, I would not want to participate in it because it is dangerous

Similar environmental considerations were addressed by other interviewees prior to their decision-making. For example, Interviewee (B) commented:

> I check the weather forecast before any event; in principle, I will never participate in an ultramarathon race if it rains; I would also not attend any marathon events under high temperature.

Most endurance sport participants in this study have experienced risks and uncertainties presented by the natural environment, some of which had led to withdrawal. Interviewee (A) gave an example of his first-time participation in an ultramarathon event in 2017:

> The racing course was in a cold, high-altitude region (average 4,000 metres), therefore, weather can change rapidly. When I was at 60 kilometres, we encountered a blizzard, and it was getting severe as we continued, I could not even see the road [. . .] I had never experienced such weather conditions before [. . .] after 15 minutes of consideration in the shelter, I decided to stop.

Due to the severity of the weather condition, it was too much for Interviewee (A) to handle. Hence, it was a safer choice to withdraw from the race.

Interviewee (M) shared his decision to withdraw during an Ironman contest, due to the weather and its impact on his physical condition:

> I was riding upwards on a hill, and it was at 70 miles when the rain started pouring down. It was so heavy that I could barely breathe. I endured the hazard till I reached the top and then rode for another 20 miles. As I continued, I became so cold and thought to myself, I cannot keep riding like this for another five or six hours, so decided it was time to withdraw.

The decision to withdraw during an event is usually an incremental process. Athletes do not decide to stop the race suddenly, as Interviewee (M) mentioned it took him almost 40 minutes to finally make the decision: "I continued until the point when the cold temperature was so unbearable, I was afraid of becoming hypothermic if I continued". Hence, from a risk prevention point of view, it was the right time to discontinue his participation.

4.2. Interplay with physical conditions

For some participants, physical conditions play a key role in leading their decision to withdraw from participating in an endurance sport event. For example, Interviewee (K) stated the importance of physical preparedness in their decision-making:

> Before I decided to enter an event, I would ask myself, 'Am I feeling okay?' 'Have I trained enough in running, riding, and swimming lately?' and if the answers were no, then I would not go for it imprudently.

It is not surprising for participants to withdraw from an event without being fully prepared physically. During an event, physical conditions were also reported as a main reason for athletes' withdrawal. For example, Interviewee (D) mentioned that during a road cycling race, his bicycle crashed which led to a compound fracture in his left arm and as such, he had to terminate his participation. Interviewee (E) had to discontinue due to an incident that occurred during an Ironman event in the United States, which led to serious injuries

on his back and crashed his bike. Moreover, under the interplay of severe weather conditions, some participants would consider withdrawing despite their physical preparedness, as Interviewee (H) commented:

> Running in the city is okay for me, but for triathlon events I always check the weather because I do not like riding on a slippery road, so if it rains badly, even if I have trained myself enough physically, I will think twice before going [to the event] because I don't want to get injured.

Interviewee (I) echoed with this point: "water temperature is a big concern for me, and if the weather condition is really bad, or the water is too cold, then I would choose not to go even if I am well-prepared physically".

Evidence further suggests that participants' physical condition led them to react differently in the face of environmental risks. For example, Interviewee (G) encountered a stormy weather during his triathlon event in Plymouth, UK:

> Despite the weather, the event organiser announced a 'go-ahead' with the swimming event. When I jumped into the water, the waves were so high that when they hit me, I was pushed under the water and could not breathe in air for a few seconds. That really scared me because it affected my breathing cycle.

However, Interviewee (G) did not stop his race because "I felt that I was still physically strong enough to finish the race". This suggests that the participant's physical status interfered with their judgements of the risks presented by the environment.

4.3. Interplay with psychological conditions

Participants' psychological status has also emerged as a vital factor affecting their decision-making to continue or withdraw from an event. Interviewee (L) gave an example of how her psychological conditions led to the decision of withdrawal:

> I registered for the UK Ironman in July this year (2021), but I was not confident enough to participate in it because I have not trained myself in swimming for nearly a year due to the pandemic, plus I know from research that this race is really difficult.

However, when intertwined with the severity of weather conditions, psychological conditions can lead to mixed decisions of withdrawal or continuing, depending on the individual circumstance, such as *the level of self-efficacy* or *personal goal of participation*, as Interviewee (A) commented:

> Giving up before the event starts just because of the weather condition is like you are surrendering yourself without putting up a fight, so I would prefer to at least give it a try, sometimes it is about having that breaking-through moment.

For those whose goal of participating in an endurance sport event was to achieve a personal challenge, they are less likely to get influenced by factors, such as weather conditions, or other participants' behaviour during the race, as Interviewee (C) highlighted:

> Endurance sport is different from football or basketball, it is a battle between you and yourselves, a monologue [. . .] I would not care about others, how they make their decisions, or how bad the weather is, as I will only focus on my goals during my race.

Interviewee (N) made a similar point about the impact of personal goals and expectations of an event on his decision-making:

> Running marathons is about overcoming challenges, and I know that I will always face some risks because that is part of the sport [. . .] I have to overcome them regardless of the weather conditions.

In parallel, when a participant's goal of participation was not about challenging oneself, but for health reasons or event experience, severe weather conditions can sometimes lead to a risk-averse behaviour. Interview (B) explained:

> For me, participating in endurance sport events is not about competitive performance, rather, it is more about the experience. A bad weather is not necessarily going to bring a good memory to me [. . .] the prospect of getting injured is just not worth it.

4.4. Interpersonal influence from other people

Support from other stakeholders (e.g., family, event organisers, fellow participants) can also affect participants' decisions to (dis)continue the event despite the environmental risks. Interviewee (C) exemplified this with his triathlon event experience:

> The water was so cold on that day, and I was thinking about stopping during the first lap. But my family and friends were on site to support me for the first time, so I decided to grit my teeth and keep going until I finish the swimming stage.

It appears that Interviewee (C) took a risky decision (to continue) when faced with the environmental uncertainty because of the presence of his family, which contributed to his confidence.

Event organisers, including personnel who provide event supplies, medical care, traffic marshals, volunteers, and shelter cars, were also indicated as vital for athletes to compete safely in an event. Interviewee (I) mentioned that she would always check the event guide and attend pre-event briefing provided by event organisers because: "different races have different rules [. . .] having the most updated information, for example, schedule, course and checkpoints, about the race can boost my confidence under environmental uncertainties".

Some interviewees even highlighted that they would consider event organisers' reputation in event risk management before deciding which event to participate in. As Interviewee (L) commented: "event organisers' responsiveness to environmental emergencies, such as time needed to make decisions, and rescuing capacity, such as number of rescue staff, on site are important elements for me to consider".

Interviewee (A) described how the presence of event supplies can make a difference:

> Event supplies to endurance athletes is like gasoline to cars. It not only provides energy to your body, but more importantly a psychological comfort, because you would think 'great, I have passed another supply site, I am one step closer to the finish line', and such hint helps strengthen your determination to finish the race.

Interviewee (H) echoed with this point and commented on the rescue teams during a swimming event:

> I was scared of water, but when I saw the rescuing teams and their boats floating around me, I thought to myself, 'if I cannot continue anymore, I could just raise my hand and they would pick me up from the water'. That gave me a lot of courage to continue my race.

In parallel, some interviewees highlighted that during long-distance events, event organisers are sometimes slow to react to the environmental uncertainty and risks for various reasons. For instance, Interviewee (I) mentioned the delayed communications between participants and organisers in facing with sudden change in weather conditions. Interviewee (A) mentioned the different risk perceptions towards the weather conditions, especially when the event staff are located in a shelter, i.e., a closed and protected space, whereas participants are directly exposed to the hazardous weather.

A similar effect was identified in the role of fellow participants. Some interviewees indicated that they like to observe and sometimes follow other participants during the race to inform their own decision-making, as Interviewee (I) illustrated:

> When other participants before me retreated from their courses and said to us 'do not continue, it is dangerous ahead [. . .]' I would consider their suggestion, particularly if they are experienced runners, and when they started to show agony on their faces, something must be wrong.

Interviewee (H) echoed with this point: "if athletes who were better than me decided to withdraw, I would seriously consider that there must be something in the race that I cannot hold up".

4.5. Individual risk perceptions

To alleviate the potential risks presented by environmental uncertainty, participants with high-risk perceptions reported to actively seek information related to the weather and route conditions. The outcome of the information seeking process plays a crucial role in participants' decision-making. Interviewee (A) highlighted:

> I always check weather conditions before an event because if I have been training for four or five months for the event, I would not allow any surprise to happen [. . .] I would try my best to consider every aspect such as the weather and be prepared.

Interviewee (M) provided an example about his recent Ironman experience in Bolton (UK), stressing the importance of taking the difficulty level into his decision-making: "Before attending the event, I checked relevant weather and route information online and found out that this was an extremely difficult event because the roads are very hilly and steep [. . .] it helped me adjust expectations".

By grasping the weather and route conditions in advance, interviewees indicated they would be better informed in their decision-making and could adjust expectations before the event. This perspective is consistent with the framework of risk information seeking in that all these interviewees had a high personal involvement in endurance sports.

Interviewee (L) gave another example of her decision to withdraw due to the risk perception of physical injury:

> Once I registered a triathlon event and even bought the flight tickets and packed my equipment. However, the day before the event, I decided to withdraw as I felt that I was not ready – because I had been out of practice on my bicycle for almost half-a-year [. . .] I was afraid that I might get injured.

Overall, it is evident from the findings that interviewees formulate various decisions, depending on their individual physical and psychological conditions, severity of weather, goals of participation, risk perception, self-efficacy, interpersonal influence, and trade-off among these dimensions.

5. Discussion and Conclusion

5.1. Key findings

This study explored the factors that impact athletes' decision-making to continue or withdraw from an endurance sport event under environmental uncertainty. The study stands alongside previous research that endurance sport participants are exceptionally strong in their physical stamina and psychological determination to perform well at an event (Taylor et al., 2020). However, the findings also reveal a different aspect of endurance sport participants: they do consider withdrawal as an option under environmental uncertainty for reasons, such as physical health protection or to avoid bad event experience.

Our analysis suggests that endurance participants' decision to withdraw from an event is not straightforward because it is subject to the impact of several factors, including individual self-efficacy, perceptions of risk and injury, and personal goals of participation in endurance sport events. Moreover, an athlete's physical and psychological circumstances, as well as its interplay with the severity of weather conditions, play a key role in leading to the decision of withdrawal.

First, in line with the framework of risk information seeking, the current study shows that endurance athletes possess a strong *self-efficacy* that allows them to control and make decisions under risks and uncertainties (Kievik et al., 2012). The stronger the efficacy beliefs, the more determined athletes were towards their decision-making. We found that endurance participants used various sources to enhance their self-efficacy. For instance, at the pre-event stage, participants demonstated active aqusition of relevant skills and knowledge regarding the upcoming event. During the event, sources, such as social support from family and friends, event organisers, and peer participants helped reduce their self-doubt and formulate their self-efficacy beliefs. High self-efficacy makes participants more risk-taking in their decision-making under environmental uncertainty, especially when it is in concert with strong determination to complete the race. This finding, on one hand, resonates with the literature that endurance sport participants are well trained to use coping mechanisms to endure physical and psychological constraints (Connaughton et al., 2008). On the other hand, endurance participants are potentially more vulnerable to environment-associated risks because strong self-efficacy leads to risker decision-making. This is a key insight that carries immense weight for event organisers and governing bodies.

Second, our findings offer further support for the framework of risk information seeking by highlighting that participants who possess high-level *risk perceptions*

tend to be more active in seeking information related to environmental conditions, such as weather, temperature, and route conditions, because they recognise the risks involved and believed their physical health is at stake (Ter Huurne & Gutteling, 2008). On the basis of people's risk perceptions and personal efficacy beliefs, Rimal and Real (2003) identified four attitudinal groups when confronted with risks and uncertainties. This part of our findings is in line with the first group, which is characterised by a *responsive* attitude, suggesting those with high perceived risk and who possess high efficacy beliefs are normally individuals being aware of their risk status and having the requisite skills to avert the risk by enacting self-protective behaviour. However, it is also important to bear in mind that not all athletes behave responsively. Rimal and Real (2003) classified another *proactive* group, which consists of people with low-risk perceptions but high efficacy beliefs. These individuals can put themselves in danger because they are thought to be motivated by their goals, but not necessarily actively engage in ways to avoid risks.

Third, the findings reveal that each participant has a different *goal of participation* in the events. The varying goals of participation influence participants' decision-making in the face of environmental uncertainties. This is consistent with the concept of a reference point in prospect theory (Kahneman & Tversky, 1979). For some participants, a prospect, or a reference point of an event, was experience (e.g., Interviewee B). Hence, the prospect of a bad weather and injuries was considered a "loss", or risk, which must be averted. For others, sometimes an event is an important "breaking-through" moment (e.g., Interviewee A) and "a battle with oneself" (e.g., Interviewee C), which means that there is more at stake. Therefore, from a "personal involvement" point of view (Ter Huurne & Gutteling, 2008), it is worth taking riskier decision to continue the event. The risk behaviour demonstrated by participants also resonated with Locke and Latham (2002), who built on prospect theory while adding the concept of aspiration level. They suggested that an individual's decision-making process is closely linked to their desired goals, which can make fundamental differences in their required effort and persistence. In other words, higher goals often cause better performances, though Schiebener et al. (2014) pointed out that relatively challenging goals can increase the chances of risk-seeking behaviours. This finding also resonates with previous application of prospect theory to endurance sports, e.g., Maxcy et al. (2019) suggesting that achieving individual goals is more important than absolute performance in terms of finishing times and ranks.

Finally, we demonstrate that individual *physical and psychological circumstance* and *environmental conditions* interactively affect participants' decision-making to withdraw from or continue in an event. These differences in decision-making can again be explained by prospect theory, which suggests that decisions under risks may defer based on individual prospects. In the case of unprepared or waned physical conditions, it is not surprising for athletes to give up their participation in an event. This study also reveals that perceived risky environmental conditions can lead to the decision of withdrawal. However, different reactions can emerge under an interplay between environmental uncertainties and physical and psychological conditions. When faced with the same environmental uncertainties, participants with strong self-efficacy and personal involvement with their events (i.e., goal-oriented) tend to make a less rational decision to continue, whereas others may consider withdrawing despite their physical and/or

psychological preparedness due to the fear of getting injured (i.e., higher risk-perceptions).

5.2. Theoretical implications

This paper offers the following theoretical implications. Firstly, this study contrasts and complements the literature on endurance sport (e.g., McCormick et al., 2019; Taylor et al., 2020) by highlighting the potential threat of the ever-commended endurance sport culture of pursuing excellence to endurance sport athletes' physical and mental well-being, especially under the risks presented by environmental uncertainties.

Secondly, sport management research on the natural environment is dominantly about the "inside-out" perspective by understanding how activities in the sport context have impacted the environment (e.g., Wicker, 2019). In comparison, the "outside-in" perspective where the environment impacts sport activities and organisational operations has been understudied (Orr & Inoue, 2018). To address this gap, the current research has integrated the study of sport participant/consumer decision-making (D. Funk et al., 2016) into the emerging field of sport ecology (McCullough et al., 2020). In so doing, our work contributes to growing research efforts to examine sport participants' responses to climate change (e.g., Orr & Schneider, 2018; Wicker & Thormann, 2021) by demonstrating how individuals undertake the decision-making process at sport competitions under risks presented by climate change, and under time constraint.

Finally, by integrating prospect theory and the framework of risk information seeking, the current study advances our understanding of endurance athletes' dynamic decision-making process under environmental uncertainty. Despite the usefulness of the framework of risk information seeking in explaining factors affecting athletes' decision-making process, this framework mainly accounts for the rational side (withdrawal), leaving the irrational side (continuing) of decision-making unexplained. In other words, the framework of risk information seeking is insufficient to explain why certain endurance athletes would choose to make a riskier decision under the same environmental uncertainty. Some studies indicated that rational decision-making is minimally evident in reality (Simon, 1955). In light of this prior work, our research highlights the benefits of integrating the framework of risk information seeking (which assumes rational decision-making) with prospect theory, with the latter adding supplementary theoretical insights into why certain endurance sport participants prefer a risky decision (from a personal reference point of view) in an event.

5.3. Managerial implications

Understanding the decision-making process of individual athletes in facing environmental uncertainties is essential for the efficient and safe hosting of endurance sport events. Our study highlights that, despite considering withdrawal as an option, endurance athletes are trained to endure physical and psychological challenges, which makes them less likely to give up and increases their vulnerability to environmental hazards. Therefore, sport managers and event organisers should carefully monitor weather forecast and take timely interventions such as suspending or cancelling the race before a disastrous consequence occurs.

Our interviewees underlined that they consider event organisers' reputation in event risk management. They also discussed how their confidence under environmental uncertainties can be boosted by the number of rescue staff and the provision of the most updated information (e.g., schedule, course and checkpoints) about the race in the event guide and pre-event briefing. Thus, event organisers should make sure they provide an ample number of rescue staff and keep participants informed of the latest race information. Besides, our interviewees reported that event organisers tend to act slowly to the environmental uncertainties. Such slow response could potentially put athletes under risks, especially given that participants may decide not to withdraw despite the danger encountered. Hence, it is crucial that event organisers observe the situation closely, assess the environmental risks, and make a timely decision. To help with this, event organisers are encouraged to include key monitoring and performance indicators relevant to these aspects and develop staff expertise in severe weather monitoring and response. By doing so, they may demonstrate their ability to face environmental uncertainties and enhance or preserve their reputation in event risk management. Such decisions and indicators may include minimising the distance to shelters, which may lead to shorter rounds in cycling and running competitions.

We acknowledge that some of the remedies suggested above would not be achievable in races where there is a starting and end point rather than a round course (e.g., Alpine regions and mountain). In this case, event organisers should at least clearly communicate about the issue so that participants are warned about the risks taken. Along this line, we call for attention to athletes' decision to withdraw from events and proactively protect athletes' physical or mental health. The casualties of the Gansu Ultramarathon disaster might have been mitigated, should more attention be paid by both event organisers and athletes themselves to the potential risks imposed by environmental uncertainties.

5.4. Limitations and directions for future research

First, when analysing the decision-making process, we did not consider the impact of athletes' personality traits (Johnson, 2011), demographic identities (Krane et al., 2014), and cultural/normative values (Bridel, 2013). Although we recruited participants from more than one country, it does not provide full representation of the perceptions. Future research should expand the data sampling to wider geographic and cultural groups, with attention paid to the impact of factors, such as personality, age, occupation, gender, and race. Second, this study focused on a few endurance sports, such as running, swimming, cycling, triathlon (including Ironman). There are many other endurance sports, such as cross-country skiing and horse-riding, which could potentially yield different results. Future research is recommended to examine athletes' decision-making in other endurance sports and whether athletes will compete under almost any conditions in some sports. Third, our interviews focused on the races in front of the participants rather than the long-term existence of endurance sport (Orr, 2020). Analyses considering the long-term existence of endurance sports may complement the study's contribution to the sport and climate change literature.

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No potential conflict of interest was reported by the authors.

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