

## Exploring jump experience, risk perception, anxiety and self-confidence in skydiving: A mixed methods approach

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### ARTICLE INFO

#### Keywords:

Skydiving  
Ecological psychology  
Risk perception  
Cognitive anxiety  
Somatic anxiety  
Self-confidence

### ABSTRACT

Skydivers are required to interpret person-context characteristics to overcome inherent internal challenges (i.e., fear and anxiety) and external challenges (i.e., equipment malfunctions) to successfully perform. Research suggests that as skydiving experience increases, skydivers' self-confidence in their actions increases, while their perception of risk and anxiety decreases. However, there is a lack of research investigating the influence of experience and considerations of performance in extreme sports. This study examined the influence of skydiving experience on the interpretation of risk perception, anxiety and self-confidence. Participants comprised 503 experienced Australian skydivers ( $M_{age} = 40.10$ ,  $SD_{age} = 12.40$ ; 79.5 % male). Using a mixed methods approach, skydivers completed measures of risk perceptions, anxiety, and self-confidence related to skydiving, as well as open-ended questions on their skydiving experiences. The findings indicated that increases in jumping experience led to greater self-confidence, and self-confidence mediated the relationship between all elements of jumping experience and cognitive and somatic anxiety associated with skydiving. Thematic analysis reinforced that skydivers understood the inherent risks associated with skydiving, and that skydivers adopted positive strategies that promoted self-confidence and mastery to perform successfully, while also managing their interpretations of risk and associated anxiety that potentially exists. Further research is needed to better understand the interpretation of person-context situations in extreme sports and recognize the important affordances for performance.

Skydiving has long been considered an extreme sport as individuals must recognize the possibility of serious injury or death as a direct component of the sporting activity (Cohen et al., 2018; Willig, 2008). While several theoretical frameworks have focused on excitement/thrill-seeking or a pathological need for risk-taking in skydiving (see Brymer, 2010 for a review), participation in extreme sports is more nuanced than simply seeking to conquer, compete against, or defeat natural forces (Brymer et al., 2010). Rather, skydiving can result in several emotions such as anxiety, fear, risk, excitement, feeling of achievement, and satisfaction for the performer (Bołdak & Guskowska, 2016; Meyer et al., 2015; Woodman et al., 2010). Understanding how these psychological factors are associated with and influence skydiving performance has been largely overlooked in the literature (Brymer et al., 2010; Brymer & Oades, 2009). Minimal research has focused on understanding the importance of the jump

experience to skydiving participation (Lipscombe, 1999). Thus, to better understand the contributing factors to the skydiving experience, research is needed to explore the contributions of these complex person-context factors, such as understanding how previous jumping experiences influences the psychological perceptions (e.g., risk perception, anxiety and self-confidence) that contribute to engagement in skydiving (Brymer & Schweitzer, 2012; Celsi et al., 1993; Hardie-Bick & Bonner, 2016).

While skydiving is considered a high-risk sport, a recent meta-analysis by Barthel et al. (2023) illustrates that from approximately 62 million recreational skydiving jumps, the injury rate was 0.044 % (less than 2 per 100,000 cases) and the fatality rate was 0.0011 % (less than 1 per 100,000 cases). When fatalities do occur, they often happen to experienced skydivers (Fer et al., 2021), with human error attributed as the largest issue (Hart & Griffith, 2003a,b; Mele et al., 2021). Over the

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<https://doi.org/10.1016/j.psychsport.2024.102649>

Received 29 September 2023; Received in revised form 16 April 2024; Accepted 19 April 2024

Available online 23 April 2024

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last 20 years in the US, for example, over 58 % of skydiving fatalities occurred to experienced skydivers with the highest level of skydiving licence (United States Parachute Association, 2023). Yet, injuries and fatalities are not the only factors that may affect the skydiver's experience. Research exploring whether alternative events (i.e., non-fatal accidents or minor injuries, 'cutaways' - where a skydiver needs to disconnect their main parachute from the harness in case of a malfunction and open the reserve parachute, or in air near misses) impacts the performers have been neglected (Barthel et al., 2023). It is expected that these diverse range of experiences potentially elicit changes to the psychological reaction of the sport (Jong et al., 2014) and skill level of the performer. Yet, it is important to note, that while it is likely that an increased injury risk and/or equipment malfunctions will occur through increased number of jumps, these experiences may occur in isolation (e.g., experiencing an equipment malfunction may not translate to an injury or vice versa). Therefore, greater research is needed to explore whether different skydiving experiences affect skydivers' psychological attributions towards the sport, and how any changes pertain to psychological reactions, such as risk perception, anxiety or self-confidence to action, influences the perceptions and actions of skydivers.

The ecological dynamics perspective provides a theoretical foundation to examine extreme sport research by recognising how opportunities of action resonate through the interaction with the environment (see Immonen et al., 2017; Immonen et al., 2022, for a review). Opportunities during extreme sporting involvement require the performer to attune to the different affordances experienced (Immonen et al., 2018). In skydiving, it is possible that having greater exposure through greater jumping experiences (i.e., either number of jumps, equipment malfunctions, or injuries resulting from jumping) may provide more opportunities to experience actions and create adaptable perceptual-action coupling (Renshaw & Chow, 2019), leading to positive changes in the abilities and skills of performers. Consequently, the ecological dynamic perspective supports the view that a variety of factors are important because these experiences consequently provide them a basis for modifying future actions (Newell, 1986). Action in this context can be represented as the perceptions, intentions, feelings, thoughts, decision-making and behaviours that continuously emerge under the constraints of information both external and internal to the individual (Seifert & Davids, 2012). Notably, using a person-environment approach, individuals are agents that interacts with the stimuli occurring around them (Gibson, 1979), it is important to interpret the momentary different affordances available and accommodate action to successfully perform the task. Thus, using the ecological dynamic perspective may provide a unique opportunity to understand how exposure to person-environmental situations creates strong perception-action coupling and how the psychological responses adapted from skydiving experiences.

A key focus of an ecological dynamics approach to action and adventure sports is the role of constraints (i.e., features that shape our cognitions and behaviours; Immonen et al., 2017; 2022). Constraints structure the affordances on offer (Newell, 1986), for example, the skydiver will need to: (a) have cognitive awareness of the technical elements of the jump as well as facilitate their emotional and perceptual response within the task (i.e., individual constraints), (b) understand the specific rules and task requirements of jumping in different situations (i.e., how to move safely if in a difficult position; task constraints), and (c) consciously be aware of the events occurring in each jump (i.e., feeling of falling and the ability to move while in free-fall as well as structuring performance based upon the affordances occurring; environmental constraints). For example, as a skydiver perform more jumps, or is required to perform a 'cutaway or experiences an injury or near-miss situation, each of these experiences provides an opportunity to develop their perceptual-action coupling, allowing stability in their jumping action to occur in response to future affordances presented. Furthermore, the situations the performer experiences during each jump (i.e., readjustment to body position, near fatal accidents, cutaways or

equipment malfunctions, injuries resulting from skydiving incidences) would provide individual opportunities as each situation is inherently different. Variations in experiences would help provide adaptability for individual's perception-action coupling for potential future events.

Prior research has focused on different how certain factors of skydiving performance affects the individual. For example, research has examined the relationship between jumping experience (i.e., number of jumps performed) and skydivers' physiological responses (e.g., Hare et al., 2013). Findings have illustrated changes to somatic anxiety responses (i.e., physiological changes; Martens et al., 1990) between groups of skydivers. Different experience levels (i.e., high skydiving qualifications and/or comparisons in jumping experience [individuals who have completed 0 to 10 jumps compared to 10 to 50 jumps, etc.]) tend to report lower somatic anxiety compared to novice jumpers (Hare et al., 2013; Machado et al., 2022; Price & Bundesen, 2005). Meyer et al. (2015) illustrated that experienced skydivers had lower cortisol reactivity and faster recovery than novice skydivers but showed no difference on levels of subjective anxiety. To date, emotional reactions have been explored in connection with somatic anxiety (Meyer et al., 2015; Price & Bundesen, 2005), but cognitions, including negative thoughts or worries (i.e. cognitive anxiety; Martens et al., 1990) remains under-examined. As less research has focused on cognitive elements, it is unclear whether individual experiences within skydiving alters cognitive anxiety towards the task. Further understanding psychological components of skydiving, including cognitive anxiety and its relationship with jumping experience, may provide more insight into the perceptions and experiences of skydivers.

In understanding skydiving experience, ethnographical analyses of skydiving have recognised the meaningfulness of the experience to performers (Celsi et al., 1993; Hardie-Bick & Bonner, 2016). In contrast to the view of skydivers as thrill seekers (Laurendeau, 2006), skydivers have reported managing rather than maximizing risk (Brymer, 2010; Brymer & Schweitzer, 2017). Further, skydivers have reported embracing a state of being fully absorbed and engaged (i.e., the autotelic response; see Tse et al., 2021) and feelings of challenge that skydiving provides where the involvement in the task becomes its own reward while minimizing the elements of risk (Hardie-Bick & Bonner, 2016). For the skydivers interviewed, there was a level awareness of the importance of displaying competency, control and safety, supporting the importance of mastery for extreme sport athletes (Kerr & Mackenzie, 2014; Willig, 2008). Furthermore, Celsi et al. (1993) recognised that the transcendent and cathartic experiences acquired during skydiving operate as key motivations to continue and improve skydiving performance. Consequently, risk normalization occurs as performers develop from experience, along with the parallel evolution of self-confidence and identity formation (Celsi et al., 1993).

It is possible that self-confidence inherently develops through opportunities within different experiences. Self-confidence has been conceptualized as one's belief in meeting the challenge of the task to be performed (Woodman & Hardy, 2003). That is, as Vealey (2001) suggests, one of the primary contributors to self-confidence is prior success. Individuals can develop a greater level of self-confidence having previously performed the task, with increased self-confidence also providing opportunities to develop sense of self, personal agency and self-determination (Hardie-Bick & Bonner, 2016). Recent meta-analysis supports the positive effect confidence provides to performance in a sporting context (Lochbaum et al., 2022). Increasing levels of self-confidence in the ability to perform the task then subsequently reduces expected anxiety to occur (Martens et al., 1990). Negative experiences such as injury from skydiving or witnessing or hearing about a fatality provides an important step to becoming an experienced skydiver by increasing perceived control over unexpected events, rather than experience alone (Celsi et al., 1993). Successful performances that enhance confidence may lead to sustained or increased motivation, whereas when faced with a threatening situation, a loss of the protective frame can occur (Kerr & Mackenzie, 2012; Mackenzie et al., 2013). Yet,

while research has primarily focused on major injuries and fatalities within the sport, these are not the only factors that may affect the skydiver's experience and confidence. Experiences such as non-fatal accidents or minor injuries, 'cutaways', or in air near misses may also have a significant contribution to the psychological perceptions of skydivers, however, the impact of these factors within skydivers has been neglected (Barthel et al., 2023). It has been proposed that these experiences would potentially elicit changes in the psychological reactions of divers (Jong et al., 2014), research exploring the interplay between an individual's changed perception of skydiving through increased jumping experience remains scant.

## 1. The present study

Each skydive experience offers a unique set of affordances that requires the performer to interpret the person-environment constraints (Immonen, Brymer, Davids, & Jaakkola, 2022; Immonen, Brymer, Davids, Liukkonen, & Jaakkola, 2018). Yet, minimal research has explored whether jumping experiences contribute to psychological factors associated with the task such as risk perception, self-confidence and anxiety. Using the ecological dynamics perspective provides valuable insights into the importance of complex interaction between individual-environmental systems, and also allow for a greater in-depth exploration to illustrate the complex intertwined constraints (Brymer & Schweitzer, 2017). Exploring the interplay of psychological reactions to different skydiving experiences provides an opportunity to better understand how jumping experience influences changes to psychological considerations to the sport. This study aimed to better understand the person-environment relationship developed during skydiving by examining the relationship between jumping experience and anxiety and self-confidence and individuals' changes in risk perception.

This study adopted a mixed methods approach to explore (a) changes in risk perception with experience, (b) whether self-confidence mediated the relationship between jumping experience (number of jumps, cutaways and medical visits) and subjective cognitive and somatic anxiety, and (c) how jumping experience may influence psychological perceptions such as risk. It is expected that jumping experiences will develop awareness of the associated risks, while also developing opportunities to build self-confidence (Hardie-Bick & Bonner, 2016; Willig, 2008; Woodman et al., 2013), and that having an improved sense of self-confidence in the task will reduce anxiety (Kerr & Mackenzie, 2012; Mackenzie et al., 2013). To further explore the perceptions of jumping experience and psychological considerations of skydivers, this study will use open-ended qualitative survey responses to uncover the person-environmental perceptions of the factors associated with jumping experiences and the impact on risk perception. Collectively this will provide insights into any changes of risk perception and psychological considerations in skydivers as a consequence of jumping experience.

## 2. Method

### 2.1. Participants

Experienced skydivers who had completed 10 or more skydiving jumps ( $N = 503$ ;  $M_{age} = 40.10$ ,  $SD_{age} = 12.40$ , aged 18–78 years), including 400 males (79.5 %) and 103 females (20.5 %), accessed the study. All participants self-reported being active skydivers. As this study was focused on experienced sky divers, participants who completed less than 10 jumps were removed from analysis, similar to Price and Bundesen (2005) who categorised jumpers with fewer than 10 jumps as novices. Participants were asked to reflect on their solo jumping experience. A solo jump is defined as a jump where a skydiver is not engaged in a coordinated formation jump or a tandem jump (United States Parachute Association, 2022), thus we request the participants to consider their individual actions and processes during each jumping experience. Fifty-eight additional participants were excluded as they

commenced the study but did not complete the measures or were not at least 18 years old.

### 2.2. Study design

This study used a convergent mixed-methods design, whereby qualitative and quantitative data were collected concurrently in an online survey and given equal priority for interpretation (Doyle et al., 2009). A mixed methods design was chosen in order to provide a deeper understanding of jumping experience and how it relates to psychological perceptions. That is, the design enables an understanding of relationships between jumping experiences and anxiety, as well as an exploration of how individuals understand and perceive risk in relation to their skydiving experience. Online surveys are a viable tool for collecting qualitative information and can enable honest participation due to the anonymity of responses (Braun et al., 2021).

### 2.3. Measures

**Demographics and skydiving experience.** Skydivers provided information pertaining to their gender and age as well as questions associated with skydiving experience. To understand jumping experience, participants completed skydiving questions related to (a) total of completed jumps, (b) number of cutaways – representing total number of parachute malfunctions occurring that required the deployment of a secondary parachute, and (c) number of skydiving-related visits to a medical facility. Medical visits were self-reporting medical incidents that requiring medical attention that occurred from a skydiving experience such as emergency department, visits to the GP, physiotherapy or other allied health practitioner.

**Anxiety and self-confidence.** Anxiety and self-confidence associated with skydiving were obtained using a modified version of the Revised Competitive State Anxiety Inventory-2 (RCSAI-2; Cox et al., 2003). Modifications to the RCSAI-2 involved changing the theme of the questions to be specific for skydiving, for example, "I'm confident I can meet the challenge," with this statement revised to, "When I skydive I am confident I can meet the challenge."

The RCSAI-2 comprised 17 questions with responses indicated on a 4-point Likert scale between 1 (*not at all*) to 4 (*very much so*), allowing exploration of the intensity components of somatic anxiety (7 items), cognitive anxiety (5 items), and self-confidence (5 items; Cox et al., 2003). Total scores on each subscale range from 10 to 40, with higher scores indicating greater levels on each variable. The Cronbach's alpha for this study was 0.79 for cognitive anxiety, 0.79 for somatic anxiety and 0.82 for self-confidence, which was similar to the Cronbach's alpha ( $\alpha > 0.80$ ) reported by Cox et al. (2003).

**Open-ended questions.** To further explore the psychological reactions to skydiving and the influence of jump experience, participants were asked open-ended questions about their emotions and feelings of risk experienced during skydiving. In line with Braun et al. (2021), these questions were designed to be short and clearly expressed in order to be clear and allow participants to report what they felt was most important. The questions focused on the emotions and feeling of risk experienced during their first jump, during their most recent skydive, and how their feelings of risk might have been influenced by skydiving fatality or injuries.

### 2.4. Procedure

Ethics approval was granted from the University Ethics Committee. The Australian Parachute Federation (<https://www.apf.com.au/>) advertised the study through their annual newsletter which was sent out to 3000 active skydivers. The survey was completed online through Qualtrics™ (Provo, UT), and took approximately 20 min to complete. Participants completed the demographic questionnaire, followed by the RCSAI-2, the open-ended questions, and finally their risk perception on

first and last jumps. Participants were offered the opportunity to take part in a draw to win tickets for 10 full altitude jumps (approx. AUD\$400 total value).

### 2.5. Data analysis

Quantitative data analysis was conducted using SPSS Version 29. Assumption testing was conducted to determine any issues before data analysis. Exploration of the variables identified no issues with multicollinearity and was normally distributed, as determined through visual inspection of the scatterplot of the dataset, for each variable except number of jumps which was positively skewed. To rectify this issue, a log10 transformation was conducted. This corrected the skew, resulting in a more normal distribution. The transformed data for this variable have been included in the subsequent analyses. Pearson’s correlations were initially used to assess the relationship between variables. As limited research has explored the influence of different skydiving experiences, this study conducted mediation analyses to explore different models. We adopted multiple mediation models to test for specific effects in order to ascertain how each component of the jumping experience related to self-confidence and anxiety. This approach is congruent with Agler and De Boeck (2017) who advocated for an effect focused approach when exploring relevant relationships between key variables as compared to a global approach such as a structural equation model. This approach also best fits our theoretical framework regarding the factors that influence of unique person-environment interactions. Therefore, each model incorporated either jumping experience (i.e., number of jumps, cutaways, and medical visits) as the independent variable, self-confidence as the mediator, and either cognitive anxiety or somatic anxiety as the dependent variable. Consequently, six multiple regression mediation analyses were conducted using Hayes’ PROCESS macro (Hayes, 2013) using 5000 bootstrapped samples as recommended.

Qualitative data were analyzed using exploratory inductive thematic analysis at the latent level (Braun & Clarke, 2013) from a critical realist perspective. The focus of analysis was on how skydivers perceived and viewed risk and how risk perception might evolve over continued experience as a skydiver. Coding was conducted across the dataset, rather than grouping answers to individual questions, to ensure that the themes identified reflected patterns across the entirety of the data (Braun et al., 2021). All relevant extracts for each code were collated. Recurring patterns in the data were identified and grouped together into themes and subthemes. Themes and subthemes were reviewed by multiple authors and were refined to ensure analytic coherence, consistency and that themes provided a comprehensive representation of the data. Discussion amongst authors was also used to consider and manage researcher bias and reflexivity in order to ensure the validity of the analysis undertaken (for a detailed discussion on rigour in qualitative research see Smith & McGannon, 2018).

## 3. Results

### 3.1. Descriptive Statistics and correlations

Means, standard deviations, and correlations are presented in

**Table 1**  
Correlations, Means, Standard Deviations and Minimum and Maximum Scores (N = 503).

Variable	M	SD	Min-Max	1	2	3	4	5	6
1. Number of jumps	2.77	0.71	1.18–3.34	–	0.44**	0.28**	–0.23**	–0.37**	0.35**
2. Cutaways	2.77	6.47	0–96	–	–	0.20**	–0.12**	–0.19**	0.23**
3. Medical visits	0.98	2.03	0–30	–	–	–	–0.05	–0.08	0.10*
4. Cognitive anxiety	8.63	2.71	5–19	–	–	–	–	0.45**	–0.45**
5. Somatic anxiety	9.97	2.76	7–25	–	–	–	–	–	–0.32**
6. Self-confidence	30.77	6.04	10–40	–	–	–	–	–	–

Note. \*\*p < 0.001, \*p < 0.05. M = Mean, SD = Standard Deviation, Min = Minimum, Max = Maximum

**Table 1.** The three variables constituting jumping experience (i.e., number of jumps, cutaways, and medical visits) were positively related to other jumping experiences. Both cognitive and somatic anxiety were negatively correlated to number of jumps and cutaways. There was no relationship between medical visits and either type of anxiety. All three jumping experiences were positively related to self-confidence, whereas both cognitive and somatic anxiety were negatively correlated to self-confidence.

### 3.2. Mediation analyses

#### 3.2.1. Somatic anxiety

The mediation models exploring the role of self-confidence on the relationship between jumping experiences and somatic anxiety are presented in Figure 1. Direct effects between number of jumps and cutaways to somatic anxiety were present, however, no direct effect was present between medical visits and somatic anxiety. In support of our prediction, self-confidence mediated the relationship between each jumping experience (i.e., number of jumps, cutaways, and medical visits) and somatic anxiety.

Note: b = unstandardised regression coefficients: CI = bootstrapped confidence intervals based on 5000 samples.

#### 3.2.2. Cognitive anxiety

The mediation models for cognitive anxiety are presented in Figure 2. No direct effects between the jumping experience variables or cognitive anxiety were found. Self-confidence, however, mediated the relationship between each jumping experience (i.e., number of jumps, cutaways, and medical visits) and cognitive anxiety.

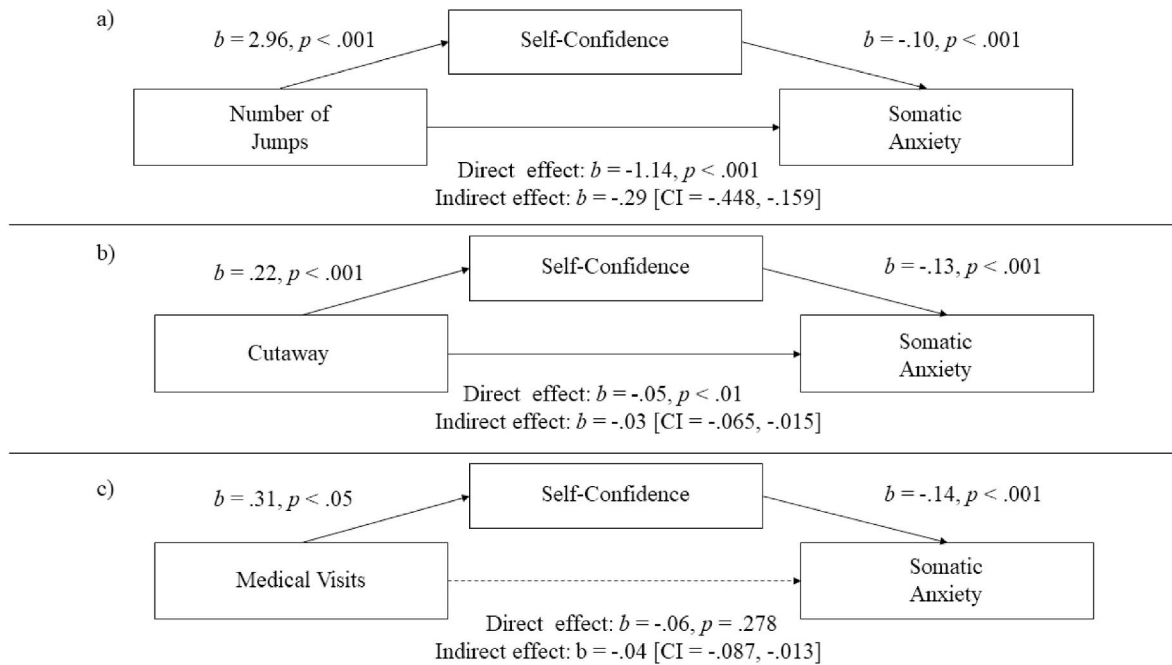
#### 3.2.3. Qualitative analysis

Across the data, there was an overarching awareness of risk as an inherent part of skydiving. In answers to all open-ended questions, injuries and fatalities witnessed or learned about over the course of their skydiving experience were described, with participants routinely demonstrating an acceptance of an element of risk (e.g., *I accept the risks and so should everyone involved; It’s important to realise the risk and still be willing to carry on*). Alongside this recurrent acknowledgement of inherent risk, simultaneous depiction of risk as both calculated (e.g., *there is a risk, but understanding that it is a calculated risk*) or as low (e.g., *Skydiving is statistically extremely safe, safer than driving your car*) existed. That is, skydiving risks were downplayed through comparison with other risks in life, most commonly driving a car, which are not typically accompanied by a strong perception of risk. In invoking this contrast, the risk associated with skydiving was acknowledged, but was also simultaneously minimized and rationalized by some respondents; an example is provided below.

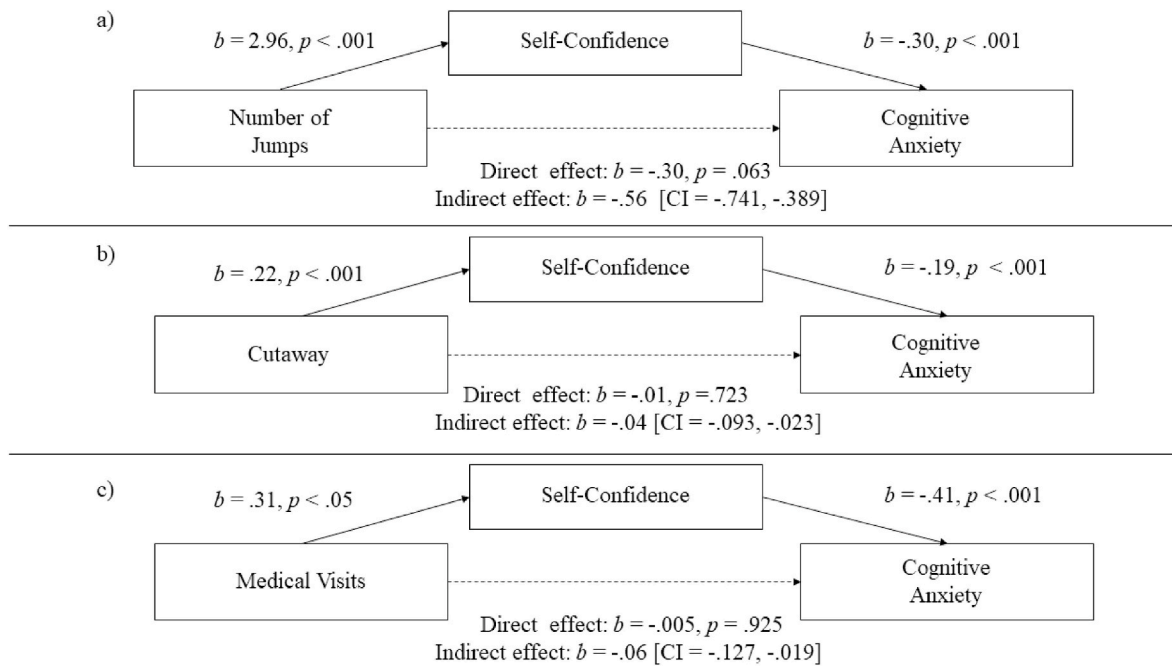
Risk is part of our sport and I accept that. I make sure I follow my check and I stay safe out there. I understand there are risk but they don’t stop me, they are more risk driving around Australia in a car then jumping out of planes and I don’t stop driving either ... I say to people do you speed sometimes while driving? If they say yes they take more risk then I when I skydive

Albeit rationalized, the awareness and acceptance of inherent risk





**Figure 1.** Mediation Model Between (a) Number of Jumps, Self-Confidence and Somatic Anxiety, (b) Cutaways, Self-Confidence and Somatic Anxiety, and (c) Medical visits, Self-Confidence and Somatic Anxiety.



**Figure 2.** Mediation model between (a) number of jumps, self-confidence and cognitive anxiety, (b) cutaways, self-confidence and cognitive anxiety, and (c) medical visits, self-confidence and cognitive anxiety.

was overarching and risk in skydiving described in three keys ways across the data – risk as something to be respected because complacency kills, as something that individuals are capable of handling, and as something that can be controlled - which are encapsulated in three themes (see Figure 3 for thematic map). Notably, while each of these patterns acknowledged risk, they also functioned to downplay and minimize the perceived risk to the individual.

### 3.3. Respect the risk: complacency kills

Recurrantly throughout the data, participants invoked a need to respect the risk. Risks associated with skydiving were presented as needing to be taken seriously and given a level of respect in order to ensure safety (e.g., *I have what I think to be a healthy fear if you want to call it that but for me it's more of a respect for what I'm doing; I have a healthy respect for risk in the sport*). Concomitantly, there was a routine description of complacency as problematic. Being complacent by not respecting the risk was viewed as causing bad outcomes (e.g., *once you*

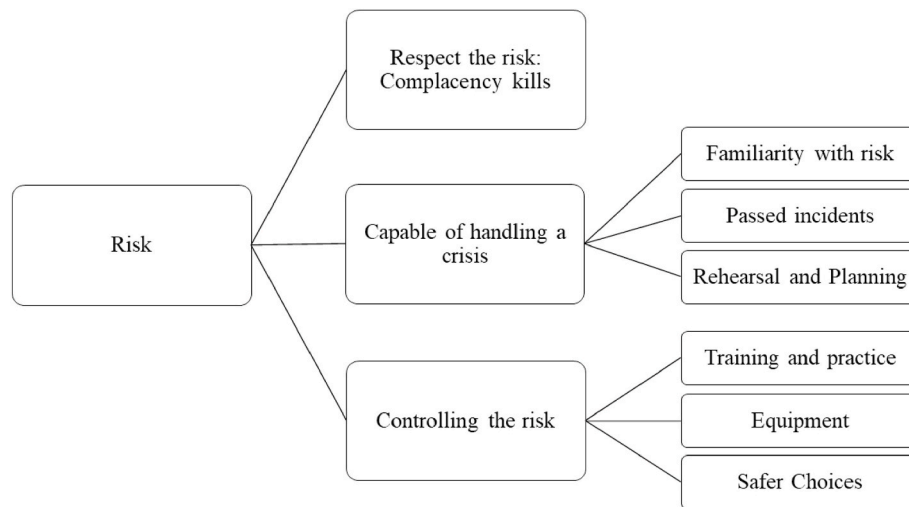


Figure 3. Thematic map of qualitative responses.

become complacent and lose respect is when you start getting hurt; complacency kills). When describing incidents such as injuries or fatalities, these were typically attributed to human error or carelessness stemming from complacency; as is illustrated below.

Unfortunately ego, the need to impress peers, complacency & hap hazard attitudes will eventuate in some sort of incident no matter what we do. Skydiving tends to be very unforgiving and the consequences of such attitudes can be devastating if not fatal.

Accordingly, complacency was viewed as dangerous. In providing accounts of accidents, respondents thus drew a distinction between the perceived complacency of those who had experienced injuries or fatalities, and their own non-complacency and vigilance. This contrast was furthered with accidents also described as serving as reminders to not become complacent; as the below quote demonstrates.

It's like a wake-up call. Complacency kills, so it's almost like a reminder to not relax and become complacent to the associated risks

In depicting incidents as due to complacency and drawing a contrast with their own respect for the risk, respondents thereby maintained their own sense of safety and minimized the perception of their own individual risk.

### 3.4. Capable of handling a Crisis

A further way in which the acknowledged risk of skydiving was depicted, and ultimately minimized, was through a perception of being capable of managing risky situations. Participants often described themselves as capable skydivers who were confident in their ability to manage potential incidents. This confidence, developed over the course of their skydiving experience, served to maintain a sense of personal safety and, thus, downplay risk; as the example illustrates.

The feeling of risk is more the balance of problem vs ability to solve that problem. I have been jumping for 38 years, and had many incidents. But I am confident in my ability to handle these situations.

Three subthemes were identified representing ways in which a belief in capability for handle risky situations was presented – familiarity with risk, past incidents, and planning and rehearsal.

**Familiarity with risk.** A proportion of respondents described themselves as familiar or comfortable with risk from other life experiences, such as through working in higher risk industries or in risk management. As such, they viewed themselves as having the requisite skills and

abilities to identify and handle risky situations in skydiving; an example is provided below.

As a member of the Australian Army I deal with death and risk taking as part of my job.

**Past incidents.** A number of respondents described near misses or incidents that they had experienced throughout their skydiving careers. Having successfully handled these incidents and averted a poor outcome functioned to increase confidence in their own ability to manage future risky situations, ultimately decreasing their own sense of perceived risk; as is illustrated below.

At the time was too busy dealing with the situation. On reflection it was an initial "oh shit" and the training kicked in to deal with it. Again there was a massive sense of achievement because you had handled the situation, which further builds your confidence

**Planning and rehearsal.** The final way in which respondents presented themselves as capable of handling risks was through planning and rehearsal for potential incidents. Anticipating hazards or risky scenarios and planning for how to manage these was commonly described. Mental rehearsal of these plans furthered a sense of being prepared for and capable of managing any future risky scenarios; as is demonstrated in the following quote.

my mind was running through any possible scenarios it could think of to imagine what I would do in that scenario. Overall I felt confident about the jump with an added focus on identifying where some unseen risks may lie.

To guide planning, respondents frequently described studying incident reports. A continued focus on learning from other incidents and incorporating these learnings into their planning, alongside mental rehearsal of these plans, further enabled participants to feel confident in their ability to handle risk, as the examples below show.

I try to find out the details of any fatality so that I can learn from the event. I have sourced fatality reports so that I can avoid similar mistakes and have the answers at hand, so my decision-making is quick in the event of an emergency. This helped with the two cut-aways I have had, caused by line twists as I had read 5 fatality reports with the same problem, so I cut away high.

It's good to have knowledge about what caused these incidents/fatalities. In case something similar happens to me, I'd say, I'd be ready for it

Experiences of near misses and incidents to themselves and others,

thus functioned to increase confidence in perceived personal capability. In presenting themselves as capable of managing inherent risks, respondents ultimately minimized the sense of risk to themselves.

### 3.5. Controlling the risk

Most commonly, respondents described a belief that risk (or level of risk) in skydiving can be controlled. This perception of risk as controllable allowed respondents to minimize their own sense of risk through a range of strategies for controlling and, subsequently, mitigating risk (e.g., *You can't eliminate the hazard, you can only control the risk; you can minimize them (risks) to a level where you feel comfortable on accepting the risk associated with the activity*). Three subthemes were identified in the ways risk was presented as being controlled – training and practice, equipment, and safer choices. Commonly, participants invoked several or all of these subthemes in their responses.

**Training and practice.** Regardless of jumping career stage and level, respondents oriented to a need to trust and rely on training in order to ensure safety. Ongoing training to learn new skills and continued practice of jump skills and emergency procedures were described as central ways in which skydivers controlled their risk and thus increased their sense of safety; as is highlighted below.

The last jump I did, I had very little fear. I have learned that if you follow your training procedures you are quite safe.

Just completed a canopy course, which taught me better flying techniques ... Was excellent and informative and lifted confidence

**Equipment.** The careful use and maintenance of equipment was another way in which individuals reported that risk could be controlled. Having high quality equipment, ensuring that equipment was routinely serviced and upgraded and suitably packed, as well as checking equipment prior to each jump were ways in which participants described controlling the risk, thus also enabling participants to feel a sense of safety; as the following quote shows.

Good, consistent gear checks, packing, pre-flight checks helps to keep me calm confident that everything will turn out OK.

**Safer choices.** Another way in which risk was described as controllable, albeit less common than the other subthemes, was through the choices that can be made to mitigate risks. Such choices included only jumping in certain wind, weather and light conditions, and within current skill limits (e.g., *I don't jump if i think the conditions are not right for me especially with wind*). Thus, while external factors might not be controllable, individuals retained a sense of personal control over these elements through their choices. Most commonly, however, safe choices pertained to who respondents elected to jump with. Echoing concerns around complacency, respondents described careful selection of who they jump with as a key choice for minimizing their own risk, as is demonstrated below.

Most accidents these days are cause by human error. One thing I tell people is "know your shit" I won't jump with people that don't understand there {sic} gear and emergency procedures.

## 4. Discussion

A mixed methods approach was used to explore the influence of skydiving jump experience on psychological aspects of skydiving, namely self-confidence, anxiety, and perceptions of risk. This study highlighted the interplay between jumping experience (i.e., number of jumps, cutaways, and medical visits) on risk perception, self-confidence, and subjective anxiety, with findings illustrating the importance jumping experience offers performers. The qualitative findings provided further insight into how jumping experience might influence skydivers' perceptions, especially around how experiences such as cutaways and

injuries increase confidence and thus downplay perceptions of risk. The results highlight that the complex interactions between the person and context significantly contributes to the perception of subjective anxiety, risk, and self-confidence, and further elucidates *how* these experiences influence confidence and risk perceptions.

Multiple skydiving experiences have been suggested to enhance the mental and physical capabilities of the skydiver (Griffith et al., 2015). It was expected that engagement in high-risk sports would increase self-confidence (Willig, 2008), and that self-confidence would help reduce the influence of anxiety (Kerr & Mackenzie, 2012; Mackenzie et al., 2013). The observed connection between increased jump experience (i.e., number of jumps and number of 'cutaways' experienced) and decreased levels of anxiety supports previous research conducted on somatic anxiety and emotional responses experienced during skydiving (Hare et al., 2013; Meyer et al., 2015; Price & Bundesen, 2005). Interestingly, the mediation findings highlight that the direct pathway between any of the jumping experience and cognitive anxiety, as well as medical visits to somatic anxiety, were not directly associated. This finding illustrated that jumping experiences alone did not alter individual's anxieties within the sport. It is plausible that increases in jumping experience led to an increase in self-confidence, and self-confidence mediated the relationship between all elements of jumping experience and cognitive and somatic anxiety associated with skydiving. This finding reinforces the claim that self-confidence is a crucial component of continued participation in high-risk sports (Griffith et al., 2013; Woodman et al., 2013).

From our findings, it remains unclear whether a linear relationship exists between jumping experience and confidence. It is likely, however, that the complex person-context factors experienced during skydiving provide a function in the development of the performer, supporting the views discussed by Barthel et al. (2023). Interpretation of the findings of the mediation analyses as well as the themes extracted in the thematic analysis indicated that participants recognised the importance of experience for developing confidence in their performance. In recognition of the dynamic affordances offered within the environment during skydiving, jumping experience provides opportunities to become skilled performers and handle negative events if they occur, and experiencing different events likely alters the psychological reactions to the event (Jong et al., 2014; Willig, 2008). Thus, while skydivers' anxiety is likely to fluctuate due to the events experienced, participants indicated that having these experiences develops self-confidence to successfully perform. Therefore, we need to better understand the complex contributing effects jumping experiences has on interpreting skydiving. Understanding how events occurring performance influence the interaction between the individual, the nature of the task, and the affordances recognised within the environment, regardless of number of jumps experienced.

Qualitative results also highlighted how confidence can increase over the course of skydiving experience and how this influences risk and anxiety, extending the limited literature of the skydive experience (Lipscombe, 1999) and further investigating the role incidents such as cutaways influence skydivers (Celsi et al., 1993). The findings reinforced that the skydivers in the sample recognised the importance of risk considerations for their skydiving performance. Skydiving experience contributed to increase confidence in their own actions and increased perceived ability to manage risky situations or future incidents. That is, the diverse experiences occurring in skydiving (i.e., jumping with no issues to jumping where dangerous incidents such as cutaway or becoming injuries occurred), as well as learning about fatalities and injuries in other skydivers, reduced perceptions of risk experienced. Involvement in diverse past experiences, for example, provides opportunities to understand the constraints occurring towards the possible options for actions, supporting the ecological dynamics perspective within action sports (Immonen et al., 2017, 2022). Consequently, these results support the suggestion that it is the increased opportunity to experience a diverse range of skydiving situations that develops an

individual's capability rather than experience alone (Celsi et al., 1993).

Participants acknowledged a level of risk in skydiving, similar to the findings of Lipscombe (1999). This finding supports the idea that skydivers recognize the risk involved in the sport, and that greater experience changes how this risk is considered. Various aspects of actual experience (i.e., number of jumps, medical visits, cutaways) and vicarious risk (i.e., learning about adverse jumps with other skydivers) all relate to risk perception, increase confidence and decrease risk perception. Celsi et al. (1993) theorized that a curvilinear relationship may exist between experience and risk perception as a consequence of actual and vicarious skydiving experiences. Therefore, experienced skydivers who have never experienced issues when skydiving, such as equipment malfunction or vicarious death and injury, should record comparatively low risk perception scores. Similar to Celsi et al.'s (1993) recommendations, further exploration of the pathways and trajectories of risk perception in line with increased number of jumps and diverse events continues to be needed to better understand the role of vicarious and direct experiences on risk perception.

Skill development and training, mental rehearsal (i.e., preparing and training for potential adverse experience), and choices around equipment (type, maintenance, checking) as well as jumping choices such as who to jump with, were all ways in which participants described managing or mitigating the risks associated with skydiving. Notably, a belief that skydiving represents a calculated risk that can be controlled through skill, preparation, and decision-making influenced risk perceptions. Furthermore, a sense that a lack of management of risk, such as through complacency, is a key source of danger. These results align with previous research highlighting the role of task mastery and control of perceived risks in skydiving (Celsi et al., 1993; Hardie-Bick & Bonner, 2016; Kerr & Mackenzie, 2014; Willig, 2008), in promotion of optimal safety in the jumping experience rather than exacerbating risky elements of performance (e.g., Hardie-Bick & Bonner, 2016; Willig, 2008). In particular, participants described ways in which risk to themselves was lesser than for others or was minimized. Thus, in line with suggestions that skydiving is more nuanced than risk-seeking (Brymer et al., 2010), skydivers appeared to reduce risk perception, rather than seek out high-risk thrills.

## 5. Practical implications

Taking the different findings together provides an indication of the importance of experience to enhance the ability to recognize the potential issues that could occur, plan for adverse situations, and have the intent to control components of performance to limit increased risks from occurring during skydiving. These outcomes illustrate that external and internal influences that impact the skydiver's consideration of risk. Key findings also support the theoretical importance of the interaction between person-environment-task constraints for extreme sports, as posited within the ecological dynamics perceptual literature (e.g., Araújo et al., 2019; Immonen et al., 2017, 2022). For successful and safe performance, for example, the participants reported a need to accurately perceive elements (e.g., inherent recognition of apparent risk, complacency kills) to fittingly deal with the demands of the task. This included appropriate recognition of individual (e.g., training and practice), environment (e.g., familiarity of risk, past incidents), and task affordances (e.g., promoting safer choices, planning and rehearsal). Increased experience exemplifies the opportunity that individuals are exposed to different affordances allowing individuals the opportunity to be adaptable and attune to the important opportunities to perform successfully (Renshaw & Chow, 2019). Utilising these findings in an applied setting highlights the importance of athletes, coaches and instructors being able to discuss experiences that occur during extreme sports in order to recognize and reflect on the perceived opportunities for actions. This approach could make individuals more aware of perceptual-action couplings and the recognition of different constraints and affordances present.

## 6. Limitations and future Directions

Risk takers in extreme sport often occur within a heterogeneous setting, and individuals are often driven to high-risk sports by a range of motivations, temperaments, and expectations (Bołdak & Guszowska, 2013, 2016). While the current study illustrates the important interplay of experience towards anxiety and the influence of confidence, research exploring whether generalization to other high-risk sports is necessary. Researchers (e.g., Brymer, 2010; Cohen et al., 2018) have discussed issues with categorizing different extreme sport based upon risk. That is, within parachuting sports alone, different levels of risk exist between the different skydiving variations (e.g., individual skydiving, tandem skydiving, freestyle skydiving, wingsuiting, jumping in groups), thus, it is possible that the current findings may vary as a result of the conceptualization of risk in other extreme sports.

Future research should also attempt to better understand factors that contribute to the ability to attune to the different affordances available. It is important that research continues exploring how individuals interpret affordances available during extreme sports and whether additional factors such as other psychological variables and/or demographics such as age or gender influence decision-making, motivations, and psychological reactions. Research exploring these approaches could further identify whether specific person-environmental experiences have a stronger positive or negative contribution to the performer. For example, the current study examined active skydivers, but it would be relevant to determine whether certain events contributed to individuals who have withdrawn from performing (i.e., did a certain jumping experience led to sport participation withdrawal due to an increase in anxiety and/or decreased self-confidence). It is possible that participation or witness certain skydiving events at different points within the development process may contribute to withdrawal.

Categorical licencing system have been used by various national association systems such as the United States Parachute Association to determine categorise skydivers. Given that numerous international skydiving associations adopt a categorical approach to quantifying skydiving experience based upon number of jumps conducted, accumulation of freefall time and ability to perform set tasks such as land close to a location (e.g., United States Parachute Association skydiving licencing categories; United States Parachute Association, 2022), it is plausible that professional organisations and researchers need to reconsider how to conceptualise jumping experience. Future research may also wish to explore the influence of skydiving from a more categorical approach is optimal to understanding factors that influence skydiver performance.

Finally, this study recruited a large sample of experienced skydivers to explore the influence of jumping experience towards anxiety and self-confidence, however, it is possible that the data is vulnerable to bias as information was collected using a cross-sectional approach employing self-report measures; there was no objective measure to ascertain the accuracy of responses (Meltzoff & Cooper, 2018). A longitudinal research design may provide standardized elements associated with jumping performance while also leading to a clearer explanation of the influence affordances have on risk perception, anxiety, and self-confidence. Furthermore, future research could explore specific strategies and psychological skills used during skydiving to better understand the holistic experience of skydivers. For example, research may wish to extrapolate differences between actual and vicarious influence of risk events on perceptions. Future research may explore psychological skills training that could be included to provide opportunities to examine extreme sport experiences. It is possible that psychological skills training such as an imagery or mindfulness training program could be used to reflect on past experiences to recognize the importance of present constraints and affordances.



## 7. Conclusion

The jumping experience during skydiving provides a profound inherently rewarding opportunity to the performance (Lipscombe, 1999). Exploring the person-environment interactions of skydiving illustrated that skydiving jump experience influences anxiety and self-confidence towards skydiving performance and perceptions of risk. The skydivers greater experience contributed to better recognition of the inherent risks associated with the sport, and jump experience provides the opportunity to develop behaviours to control these risks while also promoting tasks that increase the mastery and confidence of performers, supporting previous extreme sport research (Celsi et al., 1993; Hardie-Bick & Bonner, 2016; Kerr & Mackenzie, 2014; Willig, 2008). More specifically, great diverse experiences offered greater opportunity to link key affordances within the person-environment situations and promoted optimal action to deal with the variety of issues potentially experienced. These findings clarify the importance of distinguishing the risks associated with skydiving, and how jump experience promotes the development of confidence and reduces anxiety for the task, thereby diminishing perceptions of risk. Additional research is needed to verify and further understand the recognition of important affordance and interpretation of individual, task, and environmental constraints. Having previous skydiving experiences enhances the perception and action couplings needed for successful performance in extreme sports.

### CRedit authorship contribution statement

**Dominic G. McNeil:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Michael Fell:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Natasha M. Loi:** Writing – review & editing, Formal analysis. **Timothy P. Chambers:** Writing – review & editing, Investigation, Formal analysis. **Suzanne M. Cosh:** Writing – review & editing, Methodology, Formal analysis.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

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