©Journal of Sports Science and Medicine (2015) **14,** 340-346
http://www.jssm.org

Research article

The Situated Management of Safety during Risky Sport: Learning from Skydivers' Courses of Experience

Sara Mohamed, Vincent Favrod, Roberta Antonini Philippe and Denis Hauw ✉
Group of Research of the Institute of Sport Science of the University of Lausanne (GRISSUL), Switzerland

Abstract
The aim of this study was to determine how risks associated with skydiving can be managed within acceptable limits. Using "Course-of-Action" theory described by Theureau, four experienced skydivers viewed recordings of their jumps, from preparation to landing, to elicit their perceptions of these experiences. The sequences dealing with safety concerns were then extracted. Data analysis revealed seven typical sequences of activity to manage safety, labeled "To check the material during preparation," "To feel prepared and safe for the jump as the plane gains altitude," "To use the time of freefall," "To deploy the parachute," "To fly safely," "To ensure a safe landing" and "To organize the structured packing of the parachute." These results showed how the skydivers mitigated safety risks through a heightened awareness of critical elements in the unfolding jump activity and sequences of distributed and timed concerns and actions. The implications for accident analysis, prevention and education for training in risky sports activity are provided.

Key words: Skydiving, situated action, activity, meaning, training, involvement, subjective experience, education.

Introduction

Skydiving is generally considered a high risk sport. In the popular imagination, this assessment undoubtedly finds its source from images of skydivers plummeting to earth through empty space, scenes that evoke strong emotions associated with potentially watching someone die (e.g., Caillois, 1977; Jeudy-Ballini and Voisenat, 2004). Despite such risks and potentially fatal incidents, skydiving is practiced both recreationally or competitively (e.g., freeflying, formation skydiving) (FAI, 2011). Competitive practice and training requires particularly high concentration, strategic planning and stress coping skills, in addition to the necessary great attention given to safety concerns (e.g., Hare et al., 2013; Thatcher et al., 2003). However, Celsi et al., (1993) claimed that skydiving is indeed a high-risk sport by pointing to the finding of one death per 700 skydivers between 1978 and 1980. Skydiving is sometimes characterized as an "extreme" sport with the ultimate outcome being the intense thrill one experiences and because it exposes practitioners to a mortal risk that they are not fully aware of, especially as they multiply jumps (Loirand, 2006; Tomlinson, 2004; Vigarello and Mongrin, 1987).

Nevertheless, the position of skydiving within the field of high-risk sports appears to be more complex and contrasted than one might think. Perceptions of the relative risk are linked to the observers' concerns and their position among practitioners (e.g, insider vs outsiders) (Ball, 1998; Fuller and Myerscough, 2001). For example, many practitioners state that skydiving is a sport that arouses intense sensations in them – and not an extreme and unreasonable activity (e.g., EPCO, 2013). These testimonies have been supported by an ethnographic study of skydiving (Hardie-Bick, 2005) and accidentology research. Westman and Bjornstig (2005), for example, reported that from 1994 to 2003 the prevalence of fatal accidents was about 0.8 per 100,000 jumps, indicating that the objective risk was lower than that of other activities like motorcycle riding. A recent French epidemiology study confirmed this assertion, showing that out of 246 injury-related deaths in 2010 in France, mountain sports (i.e., mountaineering, skiing) were the most dangerous (99 deaths), followed by water sports (scuba diving), whereas skydiving caused only two deaths (Rigou et al., 2013).

Despite the multitude of forms that skydiving may take, its practice is regulated to maximize safety (Vidovic and Rugai, 2007). Four main innovations have emerged since the 80s: (a) the introduction and widespread use of safety devices that are thought to have significantly decreased landing errors, (b) the wing parachute and its automatic activation, which offers a much improved scope for piloting and a softened landing, (c) learning programs in which safety concerns are prominent, and (d) the requirement of licensing based on successful completion of practical and theoretical exams involving a minimal number of jumps. These regulations have clearly made skydiving safer, but they do not explain how skydivers manage these risks in practice (training or competition). Moreover, a qualitative study suggested that the risks do not completely arise from the sport itself and its rules and regulations, but from the way it is practiced. From skydiver's perspective, the notion of risk is not inherent to the objective act of skydiving (Penin, 2012), which in turn implies that another way to understand skydiving risk is to look at how expert skydivers manage risk.

One way to analyze how practitioners interact with risk is to examine unfolding actions. Course-of-action theory (e.g., Theureau, 2003) offers the possibility of this type of analysis as it focuses on the stream of interactions between actions and situations during a specific period of time. A course of action is defined as "the activity of a given actor engaged in a given physical and social environment belonging to a given culture, where the activity is meaningful for the actor; that is, he [sic] can show it, tell it, and comment upon it to an observer-listener at any

Received: 18 July 2014 / Accepted: 04 February 2015 / Published (online): 01 June 2015

instant during its unfolding" (Theureau and Jeffroy, 1994).

This theory has been used for studying diverse activities in which safety has to be managed, such as industrial practice (e.g., Leplat, 1995; Theureau, 2000), education in difficult fields (e.g., Flavier et al., 2003), and elite acrobatic sports (e.g., Hauw et al., 2003; 2008; Hauw and Durand, 2004; 2008). In these sports particularly, studies have shown how practitioners accounted for risk by developing a specific organization of their activity that embedded two main concerns: ensuring the viability of the ongoing activity in terms of performance (meeting set criteria) and ensuring the safety of the activity (maintaining various forms and levels of supervision of the unfolding situation). By studying how skydivers manage safety using the course-of-action approach, we thus expected to provide a better understanding of how safety concerns in this sport (a) emerge as meaningful, (b) are embedded in situation and (c) are distributed over the time of the activity.

To summarize, the aim of this study was to understand how risk is taken into account in a high-risk sport by analyzing the management of safety in situation during training in skydiving activity. Course-of-action theory was used to provide a deep and dynamical analysis of the experience from the inside of this activity.

Methods

Participants

Four male skydivers holding the Swiss license volunteered to participate in this study with an average age was 30.25 years (*SD* = 5.12 years). Two of them had seven years of skydiving experience and the other two had three years. They were all regular practitioners, training in the same club, and they had accumulated between 160 and 1200 jumps.

Data collection

The investigation analyzed four jump training sessions. Each skydiver was followed by the same investigator from the preparation of his material to landing and packing of the parachute. All had chosen their jump program without any restrictions from the investigator: three of them were freefall jumps (René, Laurent, Bertrand) and one was a wingsuit jump (Eric).

Two types of data were collected: (a) videotapes of the skydivers' activity from jump preparation to landing and (b) video-recorded and transcribed verbalizations and commentaries elicited post-activity during self-confrontation interviews.

The skydivers' activity was recorded by the second author using a digital helmet-mounted camera to collect video data, even during the jump. After the jump, the participants viewed the videotape of their own activity during the self-confrontation interview (Theureau, 2003). All of them were asked to describe and comment on their own activity (i.e., thoughts, affects, sensations, feelings) related to their recorded behaviors: as they watched their behavior, they provided descriptions of their experience. An inserted timer coupled with the image made it possible to locate the verbalizations in relation to specific moments or events of the performance. The videotapes were used to enhance their capacity to remember how they experienced the unfolding of their activity and to situate each element of experience in relation to observable events (e.g., to be in the plane, to be above the landing zone). The interviewer's prompts were designed to elicit selected components of activity: (a) the meaningful part of action (i.e., a description of action that was meaningful for the skydivers was obtained with questions like: What are you doing here? What are you searching for?), (b) the representamen (e.g., What are you perceiving? What do you see?), and (c) the interpretant (e.g., What are you thinking about? What are you concerned about?). The researcher made it a point to elicit comments from the athletes about how prominent their safety concerns were at every moment of the considered time, not hesitating to ask questions when they did not mention them spontaneously.

Data analysis

The identification and labeling of the actions were accomplished on the basis of (a) the activity videotapes and (b) the participants' verbalizations. We used an action verb followed by a direct object, an adverb, or another complement (e.g., "gets into a good position for exiting the plane," "looks at other skydivers to ensure safety distance"). The label reflected the responses to a number of questions about the skydivers' activity in relation to the action as it appeared in the video recordings and self-confrontation data. Thus, each label for an elementary unit of meaning grouped together the action and the meaningful part of it and was then called an "action unit." After identifying an action unit, we isolated the Representamen (i.e., what the athletes were focused on) and the Interpretant (i.e., what they knew, understood or felt about the situation).

Then, we extracted the action units that contained safety elements. They were included in safety sequences identified and labeled by finding relationships between the action units and their underlying constituents. Each safety sequence was made up of action units that formed a coherent chain around a meaningful safety theme for the skydivers (e.g., the sequence "To ensure a safe landing" was composed of action units that aimed at ensuring a landing in a free area, at reasonable distance from the other skydivers and with a controlled speed of approach). The sequences were labeled with an infinitive verb followed by a direct object in order to take into account the dynamics of action unit generation in the stream of activity and reflect the skydivers' meaningful safety concerns in the situation.

The timing of each action unit per activity was determined from the chronological data recorded during the self-confrontation interviews: each unit of action was timed using the corresponding moment identified by the skydiver. Then, the duration of each action and sequence were delimited by inference.

The safety sequences identified in all the skydivers' courses of action were compared, respecting the time match in order to identify interpersonal and individual components. After data collection, the coding process was

Table 1. **Description of the sequence "To check the material during preparation".**

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Completeness of secondary material	Gathers materials (gloves, helmet, altimeters)	All is OK
	Tightness of the three straps and presence of the wrists	Puts parachute on his back and checks straps and wrists	Feels calm
Laurent	Gathering the material	Manipulates material	All is OK
	Readiness of the material, tightness of the straps	Checks straps, wrists, altimeters, helmet and puts parachute on back	Feels calm and safe
Bertrand	Tightness of the straps, readiness of the parachute wrists	Puts parachute on his back, tightens the three straps and checks the wrists	No problem
	Completeness of material	Gathers the secondary scattered material	Feels relaxed
Eric	Tightness of the straps, readiness of the position of the wingsuit	Dons the wingsuit and harness, tightens the leg straps, closes the zipper and tightens breast straps	Concentrates and feels calm
	Completeness of secondary material	Takes helmet and altimeters, puts glasses around his neck	Feels completely calm

checked for inter-reliability (the agreement rate ranged from 78% to 90% between coders for the different components), which was sufficiently high (i.e., higher than 0.70, Van Someren et al., 1994).

Results

The comparison of the skydivers' courses of experience showed seven typical sequences containing safety concerns over the course of the skydiving experience. They were labeled "To check the material during preparation," "To feel prepared and safe for the jump as the plane gains altitude," "To use the time of freefall," "To deploy the parachute," "To fly safely," "To ensure a safe landing" and "To organize the structured packing of the parachute."

To check the material during preparation

This sequence comprised action units in which the skydivers' concerns were preparing the materials and checking their condition in terms of safety. Table 1 shows that each participant's activity generated both cognitive validation of the situation of readiness and a feeling of calmness. The results of the process of methodically checking everything led to a stance that emerged in the expectation of the following course of experience. The participants differed somewhat in the thoroughness of checking and the order in which it was carried out.

To feel prepared and safe for the jump as the plane gains altitude

This sequence comprised action units in which the skydivers' concerns shifted from relative anxiety to the feeling of being ready to jump. Table 2 shows this sequence in three steps (except for René) that led the participants from an anxious state to a highly focused state. The shift in states was driven by the sound of the altimeters indicating that they had reached an altitude high enough to safely use a parachute in case of trouble. This shift signaled the start of an action unit in which the concerns were about the final preparation of the jump, including safety checks.

Table 2. **Description of the sequence "To feel prepared and safe for the jump while the plane gains altitude"**

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Instrument alarms	Waits for the smooth climb of the plane	Monitors the unfolding normality of events
	Well-positioned secondary material	Puts on hood and gloves before the helmet	Increased tension for the upcoming jump
Laurent	Noise and bumpiness of the flight	Holds on to the seat waiting for a smoother situation	Monitors the unfolding normality of events
	Beep of the altisound	Hearing the altisound, relaxes and concentrates on the jump	Confidence in the next moments
	Well-positioned secondary material	Puts on helmet, gloves and glasses	Impatience and expectations of enjoying the jump
Bertrand	Instrument alarms, bumpiness of the flight	Waits for the "safety" altitude of the flight	Copes with momentary feeling of vulnerability
	Beep of the altisound	Hearing the altisound, relaxes and concentrates on the jump	Confirmation of the sound and normality of the unfolding of the situation
	Well-positioned secondary material	Checks secondary material	Subtle increase in tension in relation to safety
Eric	Instability of the situation	Waits for the smooth climb of the plane	Loss of confidence, expecting the end of this uncomfortable and hardly reassuring moment
	Beep of the altisound	Hearing the altisound, relaxes and feels safe	Identification of the normality of the unfolding situation
	Secondary materials	Puts on equipment and closes wings	Impatience, confidence and expectations of the moment of the jump

Table 3. **Description of the sequence "To use the time of freefall".**

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Level of other jumpers	Tries to slow down the speed of the fall	Understands that he is too far from the other jumpers
	Level of Laurent	Waits a moment expecting a grip with Laurent	Wishes Laurent would understand what he expects
	Beep of the altisound	Signals the end of work	Disappointment for the failed grip
Laurent	Feeling of freedom	Uses the opportunity of the freefall	Confidence in relation of the normality of the jump
	Level of the other jumpers	Understands that René would like to grip, tries to get closer	The collective jump is also great
	Beep of the altisound	Sees René's signal	Enjoyment of the jump
Bertrand	Altitude of a jumper	Moves under him, accelerates and comes back next to this jumper	Careful of the movement and the others
	Distance and speed of the other jumpers	Extends his hand	Confirms the rightness and normality of the unfolding situation
	Beep of the altisound	Shares a big smile and leaves the hand	Happiness
Eric	Sensation of balance of his body in the air	Takes a sit flying position	Confirms that the basic position is mastered
	Sensation of increasing speed	Straightens up	Careful about balance, enjoying
	Laurent's position and speed	Comes closer to Laurent	Careful about balance, enjoying

To use the time of freefall

This sequence comprised action units in which the skydivers' concerns were focused on how to move in the air during this part of the flight starting from the exiting of the plane. There were many possible actions (e.g., to draw closer to other skydivers, to increase the speed, to change position, and so on) and the safety concerns here were connected to maintaining a safe distance, the speed of other skydivers, the normality of their own position in the freefall and the beep of the altisound that ended the sequence. Table 3 describes the units of action that unfolded during this sequence.

To deploy the parachute

This sequence comprised action units in which the skydivers' safety concerns were focused on the shift from a freefall situation to a fall with a balanced parachute. The main safety concern was the correct opening of the parachute as described in Table 4.

To fly safely

This sequence comprised action units in which the skydivers' safety concerns were focused on managing the flight space in relation to the other skydivers and heading toward the landing area. The first concern was linked to safety because a collision would have very serious consequences. The second was associated with the anticipation of a good landing and thus with a form of safety. Table 5 presents this sequence in several steps that show how these two concerns were distributed over the flight time for each participant.

To ensure a safe landing

This sequence comprised action units in which the skydivers' safety concerns were focused on how to manage a smooth landing. As described in Table 6, the skydivers were focused on the landing area and the importance of having enough space for all of them, the distance to the ground, their body position and controlling the descent rate.

To organize the structured packing of the parachute

This sequence comprised the action units of packing the parachute. The skydivers remained very concentrated during this period and followed a standardized and regulated procedure to ensure the safety for future jumps, as shown in Table 7.

Table 4. **Description of the sequence "To deploy the parachute".**

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Beep of the altisound Distance of the others	Pulls upward on the handle	Feels comfortable
	Tension on the harness Form of the parachute	Has a brief look at the parachute	All is OK
Laurent	Beep of the altisound Distance of the others	Pulls upward on the handle	Monitors the deployment
	Tension on the harness Form of the parachute	Watches the deployment of the parachute	All is OK, thus feels calm and safe
Bertrand	Beep of the altisound	Pulls upward on the handle	Needs to monitor the deployment
	Completeness of material	Gathers the scattered secondary material	Feels relaxed
Eric	Beep of altisound Position of the others	Pulls upward on the handle	A little bit anxious about a possible twist in the parachute
	Tension on the harness Form of the parachute	Watches the deployment of the parachute	Feels satisfied but frustrated by the end of the fall

Table 5. Description of the sequence "To fly safely".

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Openess of the flight zone	Holds the parachute toggles and monitors the flight zone	Feels comfortable
Laurent	Openness of the flight zone Other jumpers	Holds the parachute toggles and monitors the flight zone	Realizes the impossibility of touching the parachute of another jumper too far away
Bertrand	Openness of the flight zone Other jumpers Landing area	Holds the parachute toggles and monitors the flight zone and landing area	Happiness of the flight
Eric	Openness of the flight zone Landing area	Holds the toggles of the parachute and monitors the flight zone	A little bit anxious about a possible deviation from the landing area

Table 6. Description of the sequence "To ensure a safe landing".

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Place, speed and distance of the ground	Tries to control the speed	Attention and carefulness
	Knees and contact	Lands smoothly	All is OK
Laurent	Target on the ground Other jumpers	Tries to control the distance to target	Attention
	Accuracy of the contact	Lands on the target with well-controlled speed	Feels proud of the landing
Bertrand	Distance of the ground Other jumpers	Tries to control the speed	Very concentrated
	Body sensations	Lands and runs to maintain balance	Feels happy with the entire jump
Eric	Distance and speed of the ground Other jumpers	Tries to control the speed	Feels easiness
	Body control	Lands with hardness	Feels satisfied of the experience of a hard landing

Table 7. Description of the sequence "To organize for the structured packing of the parachute".

	Activity		
	Representamen	**Action Units**	**Interpretant**
René	Rules of packing	Packs the parachute with method and reflection	Concentrates
Laurent	Rules of packing	Follows the plan for packing the parachute	Focuses
Bertrand	Sequences of actions	Packs parachute using sequences of logical actions	Concentrates
Eric	Time to go	Puts the parachute in the car and decides to pack it at home	Is in a hurry and prefers to take time for packing

Discussion

The aim of this study was to analyze how safety is managed in a training situation during a high-risk sport. The results showed that the activity could be broken down into seven sequences in which safety was in the skydivers' field of concerns. These sequences included various components like the material, environment, other skydivers and personal feelings. These components were not omnipresent concerns as they appeared at different periods in different ways. For example, safety concerns during the flight before the jump were targeted to personal involvement and material, while during the freefall the concerns were related to others and personal feelings. These results suggest that safety management emerged as multimodal concerns regularly distributed over the time of the activity. This seems to correspond to a form of the discontinuous sequences described by Theureau (2003) that arise repeatedly and specifically in many situations.

The order of these sequences indicated well-defined safety management. The safety concerns shifted from checking all personal material to concentration during the flight in the aircraft, from checking the unfolding of the situation at the beginning of the jump (freefall) to making sure that the main parachute would open correctly and then successively controlling the distance from others during the flight and the speed of landing, and finally ensuring great care in packing the parachute. This management was thus situated, linked to the needs at the very moment *hic et nunc* and the possibilities offered by the situation itself. These results are comparable as those observed in acrobatic sports, in which the supervision of the gymnast's unfolding jump was found to be distributed as a succession of actions from take-off, during the ascendant and descendant phases, and up to the landing, using the opportunities offered by these situations (e.g., Hauw and Durand, 2004; 2008).

Our results also indicated that these discontinuous sequences corresponded to various forms of involvement for the skydivers. The first one was related to an increase in carefulness and rigor dedicated to meaningful elements. For example, the skydivers showed great care and rigor with the material during the sequence "To check the material during preparation." The second one was an extreme concentration. This was observed during the sequence "To feel prepared and safe for the jump while the

plane gains altitude" when skydivers moved from anxiety to intense concentration. The third involvement was the openness to specific events. This was observed during the flight after the freefall and was related to the other skydivers. These three types of involvement suggest that safety was not merely a question of respecting rules, but was actually a way to enact them with a highly specific subjective experience that engaged the entire body and a particular mindset in relation to an environmental setting. These results indicated what it meant to "be there" in terms of safety concerns (e.g., Clark, 1997) and, perhaps most importantly, how involvement in sports performance can be considered as multifaceted and situated, which splinters the global subjective experience it is generally characterized as being, such as a state of flow, anxiety, activation or control (e.g., Nakamura and Csikszentmihalyi, 2009, Stavrou et al., 2009). We believe these results also reflect the importance of capturing the nature of the involvements in performance situations in order to reach a more in-depth understanding of athlete's activity during sports performance (e.g., Villemain and Hauw, 2014).

The results also described the evolving linkage between actions and situations as skydivers proceed through their jumps and suggest that safety is managed not only as discontinuous sequences, but also as the outcome of the practitioner's cumulative global safety concerns. This cumulative effect has been observed for other types of sports activity. For example, in table tennis, Seve et al. (2003) observed that the inquiry activity was organized in sequences that progressively informed the player of the opponent's strengths and weaknesses. Our findings showed that safety is not the addition of multiple points (i.e., material, techniques, awareness), but it is instead the result of building an organized succession of steps that generate a progressive cumulative effect and ensure overall safety. These results thus describe some of the properties observed for "edgework" (i.e., the ability to maintain over a range of situations during the jump that verges on complete disaster) characterizing this type of voluntary risky activity (Lyng, 1990).

It should be noted that there were times when safety concerns identified were managed similarly by all participants, and other times when there were clear differences. This could be interpreted as a certain irregularity in the critical need for safety concerns, such as we observed for trampolining, with three patterns of activity (Hauw and Durand, 2004). Some concerns needed immediate action, whereas action could be delayed for others, with safety somewhat in the background of the skydivers' concerns. These observations suggest that safety was also dynamically managed by a twofold process: first, action was immediate in response to critical and/or well-known situations and, second, action could be delayed in response to situations where a margin of freedom for the cut-off time was authorized. This suggests that safety concerns are organized during activity with two types of temporal horizon. Skydiving safety is embedded in the succession of two types of organization: immediate and short-term. In addition, the observation of an occasional mid-term delay in safety actions suggests that the concerns were not completely programmed but instead emerged from the adaptation to the situation, a form of improvisation in action, as labeled by situated cognition theorists (Robbins and Ayedede, 2009).

This study is presented as a case report, and it is thus impossible to generalize the results we obtained to the whole population of skydivers. In addition, other limitations to this study should to be underlined. Using a retrospective design presented methodological challenges, and the validity of building new meaning as someone explains their past experience may be questioned. However, in an enactive and situated paradigm, traces of past activity are presented to the study participants during the self-confrontation interview in order to stimulate a re-enactment process (Hauw, 2009; Hauw and Bilard, 2012). The participants were also expected to adopt a specific stance that consisted of reliving the flow of their own past experience while deliberately ignoring the outcome, thereby increasing the authenticity of the report.

Conclusion

Our study revealed the dynamical characteristics of practical knowledge about skydiving safety, which was embedded in sequences of situational action configurations. The notion of embedded practical knowledge raises questions about the real risk properties of this sport and it could be used to develop better educational programs for skydiving performance. These programs, based on series of situational action configurations, could also help novices to more quickly grasp one of the main keys to safety in risky sports: the well-known situational awareness defined as "the perception of the elements in the environment in a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (Endsley, 1995). Such a program would help learners to embody safer activity with the various modes of involvement and their cumulative effects as a means to eliminate hazards, rather than accepting the hazards and developing add-on features to control them.

References

Ball, J.D. (1998) Comparing the magnitudes of risks and benefits. *Sports Exercise and Injury* **4**, 174-182.

Clark, A. (1997) *Being there. Putting the brain, body and the world together again.* Cambridge, MIT Press.

Caillois, R. (1977) *Le sport, l'émotion, l'espace (Sport, Emotion, Arena).* Vigot, Paris. (In French).

Celsi, R.L., Rose, R.L. and Leigh, T.W. (1993) An exploration of high-risk leisure comsumption through skydiving. *Journal of Consumer Research* **20**, 1-23.

Ecole de Parachutisme de Chateau d'Oex – EPCO. (2013) *Témoignages (Testimonies).* Available form URL: http://www.epco.aero/fr/tandem.htm

Endsley, M.R. (1995) Toward a theory of situational awareness in dynamic systems. *Human Factors* **37**, 32-64.

F.A.I. (2011) About the FAI Parachuting commission (IPC). Available form URL: http://www.fai.org/ipc-about-us

Flavier E., Bertone S., Hauw D. and Durand M. (2003) The Meaning and Organization of Physical Education Teachers' Actions During Conflict With Students. *Journal of Teaching in Physical Education* **22,** 28-38.

Fuller, C.W. and Myerscough, F.E. (2001) Stakeholder perceptions of risk in motor sport. *Journal of Safety Research* **32,** 345-358.

Hardie-Bick, J. (2005) *Dropping out and driving in. An ethnography of*

skydiving. Durham University. Available form URL: http://etheses.dur.ac.uk/2734.
Hare, O.A., Wetherell, M.A. and Smith, M.A. (2013) State anxiety and cortisol reactivity to skydiving in novice versus experienced skydivers. *Physiology and Behavior* **118**, 40-44.
Hauw, D. (2009) Reflective practice in the heart of training and competition: the course of experience analysis for enhancing elite acrobatics athletes'performances. *Reflective Practice. Special Issue: Reflective Learning in Sport* **10**, 341-352.
Hauw, D, Berthelot, C. and Durand, M. (2003) Enhancing performance in elite athlete through situated-cognition analysis: Trampolinists'course of action during competition. *International Journal of Sport Psychology* **34**, 299-321.
Hauw, D. and Bilard, J. (2012) Situated activity analysis of elite track and field athletes' use of prohibited performance-enhancing substances. *The Journal of Substance Use* **17**, 183-197.
Hauw, D. and Durand, M. (2004) Elite athletes'differentiated action in trampolining: a qualitative and situated analysis of different levels of performance using retrospective interviews. *Perceptual and Motor Skills* **98**, 1139-1152.
Hauw, D. and Durand, M. (2008) Temporal dynamics of acrobatic activity: An approach of elite athletes specious present. *Journal of Sports Science and Medicine* **7**, 8-14.
Hauw, D., Renault, G. and Durand, M. (2008) How do aerial freestyler skiers land on their feet? A situated analysis of athletes' activity related to new forms of acrobatic performance. *Journal of Science and Medicine in Sport* **11**, 481-486.
Jeudy-Ballini, M. and Voisenat, C. (2004) Ethnographier la peur [Ethnography of fear]. *Terrain* **43**, 5-14. (In French: English abstract).
Leplat, J. (1995) Course of action – semiological analysis – essay on a situated cognitive anthropology. *Travail Humain* **58**, 270-272.
Loirand, G. (2006) Parachutisme : célébration du danger [Parachuting: Celebration of danger)]. *Ethnologie Française* **4**, 625-634. (In French: English abstract).
Lyng, S. (1990) Edgework: a social psychological analysis of voluntary risk taking. The *American Journal of Sociology* **95**, 851-886.
Nakamura, J. and Csikszentmihalyi, M. (2009) Flow theory and research. In: *Oxford handbook of positive psychology*. 2nd edition. New York, Oxford University Press. 195-206.
Penin, N. (2012). *Les sports à risque: Sociologie du risque de l'engagement et du genre. [Risky sports : sociology of commitment and gender]*. Artois Presse Université, Arras (France). (In French).
Seve, C., Saury, J., Ria, L. and Durand, M. (2003) Structure of expert players' activity during competitive interaction in table tennis. *Research Quarterly for Exercise and Sport* **74**, 71-83.
Stavrou, N. A., Jackson, S. A., Zervas, Y. and Karteroliotis, K. (2007) Flow experience and athletes' performance with reference to the orthogonal model of flow. *The Sport Psychologist* **21(4)**, 438-457.
Thatcher, J., Reeves, S. and Dorling, D. (2003) Motivation, stress and cortisol responses in skydiving. *Perceptual and Motor Skills*, **97**, 995-1002.
Theureau, J. (2000) Nuclear reactor control room simulators: human factors research and development. *Cognition, Technology and Work* **2**, 97-105.
Theureau, J. (2003) Course-of-action analysis and course-of-action centered design. In: *Handbook of cognitive task design*. Mahwah, New Jersey, Lawrence Erlbaum Associates. 55-81.
Theureau, J. and Jeffroy, F. (1994) *Ergonomie des situations informatisées*. Toulouse, Octarès. (In French).
Tomlinson, J. (2004) *Extreme Sports: In Search of the Ultimate Thrill*. Hove, Firefly Books.
Rigou, A., Attoh-Mensah, J., Geoffroy, M. and Thélot, B. (2013) Une estimation des décès traumatiques liés à la pratique sportive en France métropolitaine, en 2010 [An estimation of injury-related deaths linked to sporting practices in metropolitan France, in 2010]. *Journal of Traumatologie du Sport* **30**, 159-165. (In French: English abstract).
Robbins, P. and Aydede, M. (2009) *The Cambridge Handbook on Situated Cognition*. Cambridge, Cambridge University Press.
Van Someren, M.W., Barnard, Y.F. and Sandleberg, J.A.C. (1994) *The think aloud method: A practical guide to modeling cognitive processes*. London, Academic Press.
Vidovic, M. and Rugai, N. (2007) Are hook turns a major obstacle to safe skydiving? A study of skydiving fatalities in the United States from 1992 to 2005. *Perceptual and Motor Skills* **105**, 795-802.
Vigarello, G. and Mongin, O. (1987) Corps à corps avec la mort [Hand-to-hand with death], *Esprit* **4**, 71-72. (In French: English abstract).
Villemain, A. and Hauw, D. (2014) A situated analysis of football goalkeepers' experience in critical game situations. *Perceptual and Motor Skills* **119(3)**, 811-824.
Westman, A. and Bjornstig, U. (2005) Fatalities in Swedish skydiving. *Accident Analysis and Prevention* **37**, 1040-1048.

Key points

- The skydivers' activity could be broken down into seven safety sequences.
- Each safety sequence was defined by specific involvements and directions at the very moment of the situation.
- Skydivers' safety concerns are embedded in the succession of two types of temporal horizon organization: immediate and short-term.

AUTHOR BIOGRAPHY

Sara MOHAMED
Employment
Institute of Sport Science of the University of Lausanne, CH
Degree
MSc
Research interests
Sport psychology, doping
E-mail: Sara.Mohamed@unil.ch

Vincent FAVROD
Employment
Institute of Sport Science of the University of Lausanne, CH
Degree
MSc
Research interests
Sport psychology, skydiving
E-mail: Vincent.favrod@unil.ch

Roberta Antonini PHILIPPE
Employment
Institute of Sport Science of the University of Lausanne, CH
Degree
PhD
Research interests
Sport psychology, elite performance, interpersonal relationship
E-mail: Roberta.AntoniniPhilippe@unil.ch

Denis HAUW
Employment
Institute of Sport Science of the University of Lausanne, CH
Degree
PhD, HDR (Habilitation to Conduct Research)
Research interests
Sport psychology, elite performance, doping, activity approach
E-mail: denis.hauw@unil.ch

✉ **Prof. Denis Hauw**
Institut des Sciences du Sport, Faculté des Sciences Sociales et Politiques, Université de Lausanne, Quartier UNIL-Mouline, Bâtiment Géopolis, bureau 5441, 1015 Lausanne, CH, Switzerland