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Safety–Performance Management in Extreme Sports? A Situated Analysis in Spearfishing Activity

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Safety–Performance Management in Extreme Sports? A Situated Analysis in Spearfishing Activity

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Abstract

The aim of this research is to understand safety–performance articulation in spearfishing through the study of the global, specific, and temporal organization of an elite free diver's activity. Three kinds of data were collected: diary reports, ten elicitation interviews on spearfishing, and two self-confrontation interviews on successful and failed apneas. The results indicated (1) the spearfisher's global organization during the spearfishing set, (2) the alternation of intentions during apnea and periods of stabilization, (3) harmony with the environment, and (4) the strategy of keeping pace with the fish. The article will discuss the specific competence development needed to manage the safety–performance relationship in extreme sports. Drawing on its findings, the article proposes improvements to the safety–performance relationship in risky activity.

Keywords: safety, performance, situated activity, extreme sport

1. Introduction

The term "extreme," as used in extreme sports, is rather ambiguous and can be applied to outdoor leisure activities where the most likely outcome of a mismanaged mistake or accident is death (Brymer & Gray, 2009). Mountain sports, skydiving, and scuba diving are characterized as extreme sports, with the ultimate outcome being the intense thrill experienced (Tomlinson, 2004). Other research on risky activities has focused on sensation seeking, illustrating that participants were motivated by the thrill, danger, excitement, or challenge (Brymer & Gray, 2009; Celsi, Rose, & Leigh, 1993). More recently, extreme sports literature has been more focused on positive aspects of the activity. For example, Brymer et al. conducted phenomenological interviews with 15 extreme sports athletes, targeting positive aspects of the extreme experience. Several findings from Wiersma's (2014) study are consistent with these results and suggest that extreme sport performance is less about risk-taking and more about the development of positive traits. Such studies have emphasized extreme sports' positive contributions, such as the development of courage and humility, as well as the appreciation of nature's power, environmental awareness, an improved sense of responsibility (Brymer, Downey, & Gray, 2009) or positive life skills development, and the ability to remain calm (Willig, 2008). For example, extreme sports enable humans to conquer nature, to demonstrate personal power, or to prove to themselves that they are in command of their life (Millman, 2001), thus bringing value to their life (Le Breton, 2000). Many people are looking for a new way to give meaning to their life. Participants in extreme sports also do this, and are motivated by thrill-seeking and risk-taking.

The World Underwater Federation defines competitive spearfishing as the hunting and capture of fish underwater without the aid of artificial breathing devices (e.g., when in a state of apnea—that is, holding one's breath for a long period of time), using gear that depends entirely on the physical strength of the competitor. Spearfishing involves some level of physical risk. To practice this sport, athletes have to be well equipped with specific kit: this includes fins, diving masks, snorkels, flippers, wetsuits, belts, and spear guns. International spearfishing competitions consist of competitors striving to catch the most fish during two sets of six hours (e.g., during the world championship) in a defined area of the ocean or sea. To rank candidates, judges consider the nature of the fish, their quality, and weight. Thus, the main qualities to perform well in this activity are the length achievable of each apnea, knowledge of both the environment and the fish, physical conditions, shooting precision, and descent speed (hydrodynamics). Not many studies have been undertaken in the field of spearfishing. In the best cases, research into scuba diving has been conducted in sport psychology reviews (Morgan, 1995), showing that numerous factors are responsible for the injuries and fatalities which occur and, in particular, whether they are caused by panic. This article proposes an exploratory case study of the experience of an elite spearfisher. The aim of this research is to improve understanding of how the spearfisher builds his safety and performance through training in natural settings.

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Researchers investigating extreme sports and performance have shown the existence of a "flow," defined as a state of optimal experience in which people are so involved in an activity that nothing else seems to matter (Csikszentmihalyi, 1991); the experience itself is so enjoyable that people will do it even at great cost, in order to achieve a state where physical and mental functioning constitute a unity. Flow has been associated with peak levels of experience and performance (Privette, 1981). On the other hand, negative consequences of flow have been highlighted through case studies into surfing. These have indicated that flow could be a causal factor in exercise dependence (Partington, Partington, & Olivier, 2009), and such dependence could lead to the practice of dangerous activity (Olivier, 2006). However, Partington et al. (2009) have also shown that flow could have psychological benefits for improved mood, self-esteem, and self-fulfillment.

In any dangerous activity, risks and resource management are closely linked to self-knowledge (which allows action strategies to be adjusted in order to elaborate controlled situations) and risk presence (which drives internal resource development in terms of skills or know-how) (Valot, 2001). While previous studies in ergonomics have shown the existence of objective compromise (Caroly & Weill Fassina, 2004; Gomes, Woods, Carvalho, Huber, & Barges, 2009) and an incompatibility between safety and productive objectives, other research has indicated the confusion between these two aims, which are sometimes merged into one main objective. Indeed, safety models have often contrasted safety with performance and postulated that it is impossible to reconcile these two objectives. This is the case of the practical migrations model (Amalberti, 2009): should the activity organization allow operators to migrate spontaneously towards greater performance as opposed to safety? If the system uses barriers to control such migration to avoid unwanted events, it also limits performance improvement. Thus, if performance increases, it is to the detriment of safety and vice versa. On the other hand, other studies (Morel, Amalberti, & Chauvin, 2009) have not seen a definitive contrast between safety and performance. According to these authors, it is possible to increase performance without impeding safety objectives: the operators' autonomy, know-how, or competence development to manage risk, and decision-making capacities to manage uncertainty are also possible thanks to their expertise (Amalberti, 2006). Most of the time, operators negotiate performance and safety thanks to their expertise through their trade-off decisions. This autonomy gives the system and its operator flexibility in response to various situations. The safer the system, the less resilience is guaranteed by the professional (Hollnagel, 2009; Hollnagel & Woods, 2006), because organizational rules and procedures reduce operators' autonomy (Amalberti, 2006). Consequently, in order to reach safety–performance objectives, operators have to face permanent changes, and this even more so in risky environments (Reason, 1990). These trade-offs allow practitioners to confront environmental unpredictability but can constitute a basis for risk (Flin, 2006) because decisions are made quickly and implicitly during action and have an impact upon the safety–performance relationship (Woods, 2006). In critical situations, decisions involve difficult mental negotiation in which situation awareness is an important factor for the safety–performance trade-off evaluation (Hollnagel & Woods, 2006). Operators have to collect vital meaningful information to predict upcoming situations before implementing trade-offs. Thanks to expert operators' judgement criteria in naturalistic situations we can understand how an unpredictable environment can be managed. This observation has also been made in the field of sports studies (Hauw & Durand, 2007; Mohamed, Favrod, Antonini, & Hauw, 2015).

This research follows an ergonomic approach (Guérin, Laville, Daniellou, & Kerguelen, 2007) because the safety–performance relationship has already been studied from the action point of view and through situated analysis of activity. Using ergonomics, many concepts such as resilience (Hollnagel, 2009), which are of great interest to our study, have been developed. In such risky activities, the safety question is fundamental and is emphasized when performance is enhanced. In order to respect action ecology, we will follow a phenomenological (Vermersch, 2009, 2012) investigation (situated analysis) to understand safety–performance building during spearfishing activity. The particularity of the situated analysis resides in the importance of the context. It focuses on actors' meanings during their activity. These meanings come from the emergence of the dynamic interaction context in which the actor is involved. This approach offers simultaneously the elements to understand people's experience and the development of helpful training as well as competition situations. Thus, we hope that this methodology will give us greater understanding of the safety–performance relationship. More particularly, we question the performance strategies used by a spearfisher: is it necessary to put himself/herself in danger to perform, as the Amalberti model argues? How does the spearfisher know what to do, when to do it, and how to do it?

The aim of this article is gain greater understanding of how the safety–performance relationship is built whilst the activity is being carried out, and how the spearfisher follows the situation variability to guarantee both his safety and performance. This research focuses on the construction of meaningful actions coupled to situations which reconstruct the natural and sport-specific conditions of the human activity. The natural setting in which the spearfisher performs involves the need to adapt to unexpected situations in a vast environment. A wider vision of the strategy used by an elite spearfisher in both singular and typical training conditions considers the ways in which his actions are organized, and which strategies are used in order to improve performance and guarantee safety.

The study sits in a particular context, where the spearfisher expressed his desire to work with us to improve his own performance for the world championship. Because of the high level of practice and the specificity of the activity, the case study was conducted with just one athlete, but data collection and analysis were conducted using the case study method recommended by Yin (1994). This article studies the safety–performance relationship in two main parts, based on the spearfisher's diary reports (activity traces). Firstly, it aims to understand the safety–performance relationship through the specific organization of actions; secondly, it explores the dynamics of the spearfishing activity.

2. Methods

2.1. Participant

The study has been conducted with the diver's entire cooperation. It is a single-case study focusing on a volunteer, a 38-year-old elite spearfisher. At the time of the study, he had been in the French national spearfishing team for 10 years and was ranked among the top 15 in the world. He has taken part in international competitions (world championships, European championships) for over ten years, and has about 20 years of diving experience. The data were collected in the context of preparation for the world championship. He was informed of the research approach and his consent was obtained using a signed engagement.

2.2. Data Collection and Procedure

In order to gather reliable results, we adopted a "triangulation method," which uses different kinds of data (Table 1) in order to pinpoint a subject (Denzin, 1978; Webb, Campbell, Schwartz, & Sechrest, 1966). Such an approach aims to investigate an experience, as lived, and requires the use of a multitude of data sources to explore the spearfisher's activity, such as diary reports, video recordings, and interviews.

The period of collaboration and data collection with the spearfisher lasted two months. His training practices comprised about six hour-long sessions in the sea: this corresponds to the period spent in the sea during any one day in a world championship. He went from spot to spot to catch fish. Apneas were successive and consecutive. During these sessions, many apneas were carried out (between 70 and 80 over a six-hour period). The participant wrote a diary report for two months (which constitutes the traces of his activity) in which he selected the durations of the fishing trips, attempted shots, successful shots, the average fishing depth for each fishing trip, the sea conditions, and reported his feelings, and any other elements which could have an impact upon his practice. We used his notes to facilitate the activity convocation during interviews. The scientific interest was to construct, in collaboration with the spearfisher, imprints of his activity. Afterwards, in order to understand his activity organization, the participant was invited to describe his activity from the diary notes through elicitation interviews (the phenomenological approach; Vermersch, 2009, 2012). He was then invited to describe his activity from video recordings. The spearfisher selected two apneas at about the same depth (27 meters), which corresponded to a successful and a failed situation according to his representations. Two self-confrontation interviews (Theureau, 2006) regarding these apneas were held in order to complete previous data and to explore spearfishing dynamics in depth with temporal markers.

In the first instance, ten apneas were selected by the diver to describe global safety and performance organization, using elicitation interviews. The aim was to understand specific activity organization in a safety–performance trade-off. Recorded elicitation interviews concerning ten apneas were held in order to identify the global structure of the spearfisher's activity in the safety–performance relationship. Data were collected over one hour (on average), from preparing for the apnea to the ascent. The evocation technique (Vermersch, 2000) led us to return to the apneas selected by the spearfisher in order to understand his functioning and the strategies he used. In this procedure, the spearfisher was asked to describe and comment upon his own activity related to his recorded performance. This level of pre-reflection can be reached using an elicitation interview (Vermersch, 2009). This places actors in a dynamic situation where behavior, language, and expressions are good indicators to assess whether athletes are in

Table 1
A synthesis of the data collection methodology.

Nature of the data	Diary reports	Elicitation interviews	Two self-confrontations
Content	Duration of the fishing trips, attempted/successful shots, average depth, sea conditions, feelings Meaningful units analysis	10 interviews 1 hour long each Data recorded and transcribed Meaningful units analysis	A successful situation A failed situation 1 hour long Data recorded and transcribed Meaningful units analysis
Objectives	To facilitate the activity convocation during interviews To create markers	To understand the activity organization and specificities	To explore spearfishing dynamics with temporal markers

evocation mode. From a psycho-phenomenological approach, this kind of interview means describing actions by searching for all implicit elements involved (e.g., accurately reflecting on one's own experience) (Maurel, 2009; Rochat, Hauw, Antonini Philippe, Crettaz von Roten, & Seifert, 2017; Vermersch, 2008). To facilitate evocation, questions were formulated using the present tense, brief sentences, and action verbs. Indeed, the aim of this interview is to place the athlete back in his past actions and enable him to experience them again. Afterwards, he was asked to describe what was happening at that moment. According to Vermersch (2012), elicitation interviews could be applied to retrospective introspection. For both kinds of interviews (elicitation and self-confrontation), the interviewer used a non-inductive guidance of an experience's formulation by trying to evoke past experiences. This was achieved through the employ of time and action fragmentation in questioning. These interview questions revealed how the participant had experienced safety–performance situations in relation to (a) actions (e.g., "What are you doing here?"), (b) sensations (e.g. "What are you feeling about this action?"), (c) intentions (e.g., "What are your intentions here?", "What are you looking for?"), (d) focalizations (e.g., "What can you see?", "What can you feel?"), and (e) background (" How do you know that…?"). This approach has previously been applied to soccer (Villemain & Hauw, 2014).

Furthermore, the aim was to explore spearfishing's dynamics to understand global safety–performance organization in both a successful and a failed situation. Video data recorded during apneas were collected, from the descent to the ascent. A go-pro camera placed in a hermetic box was held by another apneist who followed the free diver during his actions. Data were collected during several apneas but only two apneas were selected by the spearfisher as representative of a typical successful and failed situation. Afterwards, two self-confrontation (on average 60 minutes long) interviews were held from these videotapes in order to explore the spearfisher's activity dynamics based on the five previously mentioned steps (Theureau, 2003, 2006, 2010). Speech was recorded during the self-confrontation interviews to provide data for analysis. During the interviews, the athlete could stop the tape or backtrack at any time to comment on the footage. Videotapes were used to enhance the spearfisher's capacity to remember how he experienced his performance, in order to place each element of experience both in time and in dynamics. He was encouraged to describe his performance and his actions as he had experienced them. During the self-confrontation interviews, the spearfisher was asked to describe and to comment upon his activity ("What are you doing here?") regarding his feelings, affects, sensations ("What are you feeling?"), intentions ("What are you searching for?") and thoughts ("What are you thinking about?") related to the situations.

2.3. Data Analysis

All interviews were recorded with a digital recording device and transcribed verbatim. Firstly, these data were analyzed using a qualitative thematic approach: the researcher read each transcription several times, and used a notepad to take general notes on the meaning of the participant's statements and to get a better sense of the whole experience (Thomas & Pollio, 2002; Wiersma, 2014). The goal was to identify description patterns that reflect important aspects of an individual's experience. Meaningful units were established by underlining words that stood out as significant in the transcriptions and which answered the question *"how is this relevant to safety–performance management?"* These meaningful units were inductively arranged into categories or themes by grouping them according to similar meanings, written in a narrative format.

After the collection of both the diary reports and the interview transcriptions, the data were analyzed in three steps. The first involved identifying the categories of the safety and the performance determinants in the activity from the diary reports; we categorized all information in the reports (thematic units; Corbin & Strauss, 2008) in relation to safety or performance explanations. Secondly, we identified temporal markers of experience from the timing of each chronological sequence in both situations (success, failure), and determined the chronological data recorded during the self-confrontation interviews. Each action was timed using the videotape and the corresponding moment identified by the spearfisher. Finally, categories of experiences were identified in relation to safety–performance (intentions, actions, sensations, focalizations, and background) for each chronological sequence, from the beginning of apnea preparation to the ascent for each of the ten apneas described.

2.4. Reliability of This Qualitative Study

Reliability was established in several ways. Firstly, the results section uses the participant's language and provides rich detail of the interview transcriptions (Kerry & Armour, 2000). Secondly, validity checks were carried out by providing the participant with a copy of the interview transcription for accuracy or clarification of any of its content. This was done in order to review it for accuracy, add, or clarify anything being discussed.

From the gross data collected during the interviews, the work consisted of:

(a) Data organization. Indeed, sometimes interview dynamics do not correspond to the temporal markers of the action experienced.

(b) Selecting the useful information to reconstruct the apnea.

Consequently, this study has both internal and external reliability (Vermersch, 2003). Internal reliability involved

checking the verbalization's authenticity and ensuring that the subject talks about the action experienced. Thus, we selected only verbalization of a single and unique moment using the present tense with brief sentences and action verbs.

External reliability was ensured using a triangulation process. Here, the aim is to articulate data obtained during interviews with the videotape (observable traces). For example, when the spearfisher feels that his body is aligned (an important marker for him regarding hydrodynamics), we ask whether the athlete's discourse matches the videotape recording? The video recordings were thus used to check the correspondence between verbalizations and the specific behavior commented upon. As with all case studies, the purpose of this approach is not to validate hypotheses or establish principles. Diverse criteria were used to ensure the reliability and quality of this study following the recommendations of several specialists in qualitative research (Smith & Caddick, 2012). Afterwards, verbalizations were transcribed and the encoding process as well as comparisons of the thematic units were checked for inter-reliability, the latter being sufficiently high (90%, i.e. higher than 70%; Van Someren, Barnard, & Sandleberg, 1994). This process was inspired by previous research in this domain. Each researcher had to identify and encode categories of experiences with safety and performance parameters. Two researchers ensured the level of credibility experienced to conduct qualitative research. Transparency was ensured by an outside researcher specialized in qualitative research who reviewed the different steps of the research and made suggestions for improvement.

3. Results

Even if the study was elaborated into two main parts (specific organization of actions and the dynamics of the spearfishing activity), this part proposes four main results: the global spearfishing organization during the activity; changes in intentions at different points of the action; the harmony with the environment; and the "dance with the fish."

3.1. Global Spearfishing Organization During the Activity

As in all risky activities, spearfishing is characterized by significant environmental uncertainty. It is a complex activity presenting some constraints and which combines the management of many factors. These include wind strength and direction, swell size and direction, obscurity, depth, and the stream which determines spearfishing activity during the descent trajectory or during the shoot. During this last phase, the spearfisher must ensure that he can recover the arrow, shoot the fish properly (in the head for example), and check if he can make a double (spear two fish in one shoot). Thus, evaluation and observation of the environment, or spatial appreciation are needed to respond to the safety–performance objectives and correspond to the main determinants of both safety and performance. The apnea is structured into five steps:

(1) The apnea preparation where the air reserve is constituted, thanks to hyperventilation.
(2) The descent with flippers.
(3) The cast—that is, when the spearfisher is in a negative floatability and does not need to use his flippers as he makes the least possible effort.
(4) Depth stabilization when descent stops, and fish are approached. The shot is prepared.
(5) The ascent. Having resurfaced, the spearfisher takes a deep breath and suspends his respiration for a short time so as not to faint.

3.2. Changes in Intentions

The current results show the existence of changing intentions during the apneas (from elicitation interviews) and during the stabilization period (from self-confrontation interviews).

3.2.1 During the apneas

Elicitation interviews were used to explore the global activity of the spearfisher. The results show two main phases: the safety period and the performance period (Figure 1). In the safety period, the spearfisher's intention is to constitute and to manage his air reserve. In the performance period, he is focused on fish hunting.

Firstly, the results indicated that during apnea preparation, the descent with flippers, and the ascent, the spearfisher focused on safety and his oxygen reserve. For example, apnea preparation involves air reserve constitution thanks to hyperventilation. During this time, he visualizes his material, he tries to be relaxed, and when he feels ready he begins the apnea; the descent begins with duck diving, then he adjusts his trajectory, searching for economy of movement with his flippers, fluidity, and hydrodynamics, but also in the effort to expend as little energy as possible. He uses the environment (stream, swell) to guide his trajectory. This step corresponds to the management of the air reserve. During the ascent he focuses on his internal sensations (gliding, relaxing). He has the sensation of a lack of air, as his oxygen reserve has run out.

Secondly, the results show that cast and depth stabilization correspond to the hunt or performance period. For example, when the spearfisher "casts," he does not need his flippers and makes the least possible effort: *"I feel relaxed… Thus I am looking at where the fish will be and where I will lie down…"* He has the sensation of freedom, fluidity, and relaxation. Thus, he begins the hunt, observes his prey, and begins to think about which technique and strategy to use. Depth stabilization involves stopping the descent, and lying down on a rock, approaching the fish,

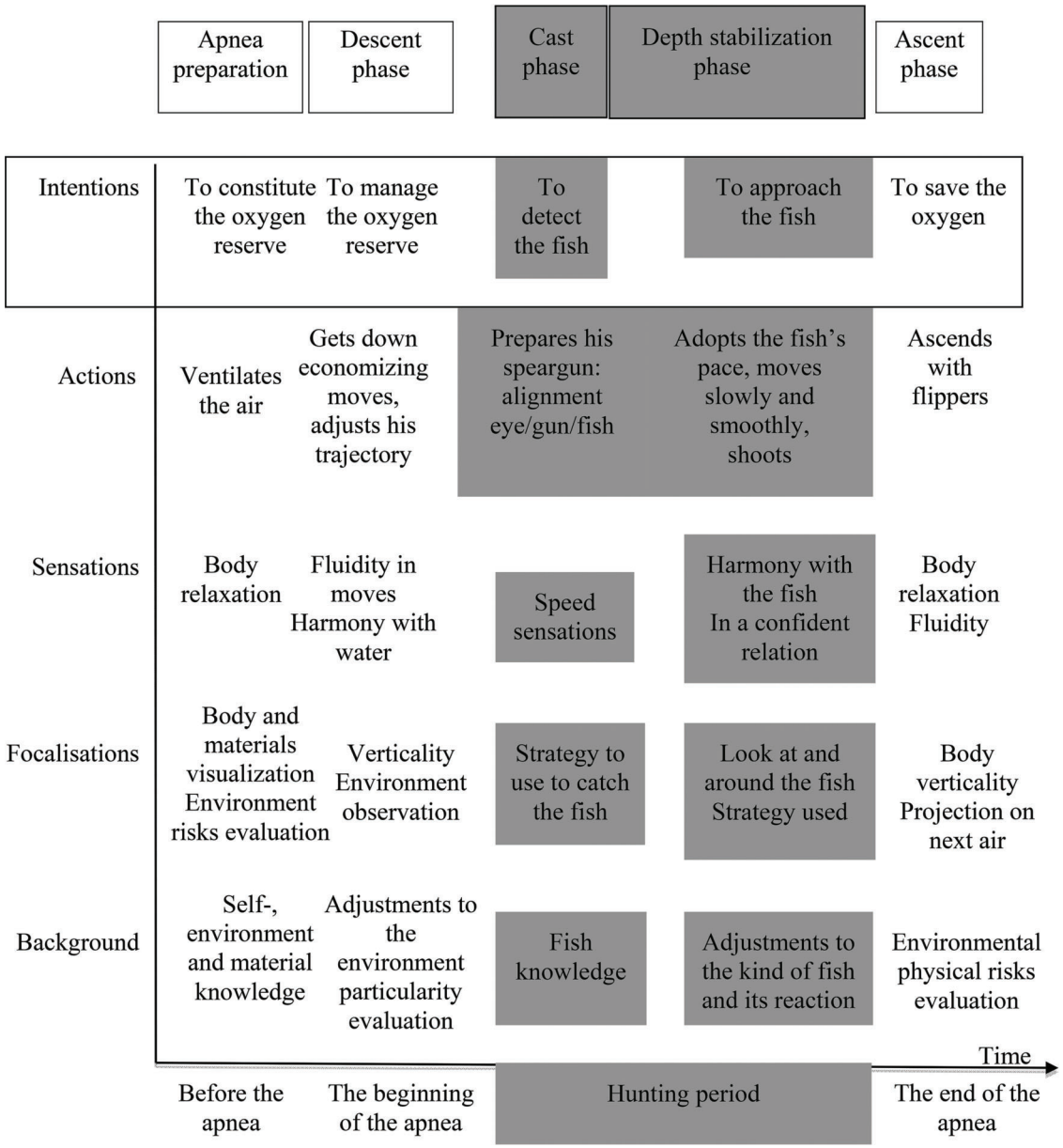

Figure 1. Safety–performance management during apneas.

and preparing to shoot. He tries to move at the same pace as the fish so that he will not scare his prey. He is in harmony with the environment and with the fish.

3.2.2 During the stabilization periods (critical phase)

Self-confrontation interviews were used to explore the dynamics of the spearfishing activity. In accordance with the diver's representations, we considered that when he decides not to shoot a fish and to ascend, it was to save his life rather than catch a fish. This choice is associated with increased apnea duration, pushing him to consider safety rather than performance. Thanks to self-confrontation interviews and the video recordings, temporal markers were incorporated into both a successful and a failed situation from the descent to the ascent (the five steps), in order to better understand safety–performance building (Figure 2). First, the results indicate differences in apnea duration between successful (ap. 1) and failed (ap. 2) dives. For successful apnea, the total duration was 1′15, contrary to failed apnea of 1′42. If the time was roughly similar for the descent and the cast step (about 20″ (ap.1) vs 22″ (ap. 2) for the descent and 10″ (ap. 1) vs 12″ (ap. 2) for the cast), this was not the case for the depth stabilization step (15″ (ap. 1) vs 35″ (ap. 2)). The duration of the depth stabilization step is longer for the failed situation than for the successful situation.

Self-confrontation interviews revealed that the stabilization step is a period in which the spearfisher had to decide whether to continue the apnea or not, and whether to change his initial intention or not (from thinking about performance

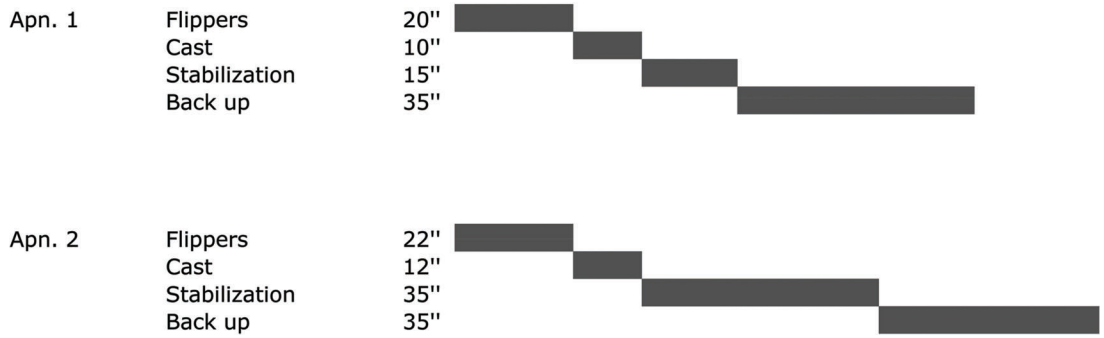

Figure 2. Dynamic activity organization according to success and failure.

to instead focus on safety): "*…I am not going to shoot because…if the arrow gets stuck, I will have to make a huge effort to recover it. There are way too many risks involved for nothing: I could need many apneas and it is too tiring and with what's coming next…and it's quite a small fish…"*

3.3. Harmony With the Environment

Internal sensations guide the spearfisher's performance during his activity. Using such internal sensation as a guide is possible thanks to the spearfisher's background (environment and self-knowledge). To be proficient, he creates a unity and harmony between himself and nature. The connection with the environment is thoroughly present through the diver's verbalizations during each part of the dive: *"I am moving in relation to the streams, so that I can make fewer movements…" (interview 3, 6)*; *"the environment tells me what I have to do…" (3)*; *"I have the impression of being like water" (3).* Thus, internal sensations play a fundamental role. They return when he is in the terminal step, and out of the hunting period. He focuses on his internal sensations: *"I am beginning to feel groggy, my legs are heavy, it is not good… I am having strange sensations in my chest, I know that I have attacked my air reserve zone…" (6).*

3.4. Keeping Up With the Fish: Dancing With Fish

The results show that the spearfisher adapts his technique and strategy to the environment's particularities to perform and to stay safe. The same technique has a double objective: to preserve his life and to be successful. During depth stabilization and the shooting period, for example, the spearfisher develops strategies to perform. One of those strategies is to keep up with the pace of the environment, with the fish. He plays with the fish and tries to adopt the same pace: *"I am trying to not move the water too much, to not scare the fish, to have slow and fluid movements in order to gain the confidence of the fish" (3)*; *"I am lying down to catch the fish's curiosity… I am trying to appear smaller and to make it believe that I am afraid" (4). "I feel that all my being is in sync with the fish, I am adjusting my behavior to its own" (9).*

"Keeping the pace" means having fluid and slow movements which in turn have an impact upon oxygen consumption, maintaining its supply and only slowly diminishing the spearfisher's reserve. Strategies and techniques are employed in order both to be efficient during the descent and to remain safe, as actions focus on economy of movement. From an action aspect, it is impossible to determine which actions are in relation to safety and which to performance. Moreover, the same technique can be valid for safety problems but also for performance: *"I feel like I don't have enough air…thus, I am focused on movement efficiency and precision" (2)*; *"I have attacked my air reserve zone… Thus I am trying to keep my verticality and feel as if I were gliding to ascend with efficiency and economy" (6).* The results indicate that the spearfisher organizes his activity in accordance with the environment, materials, and physical constraints. He thus needs to adjust his activity to perform and to be safe thanks to a specific action organization during apneas based on objectives (safety and performance), harmony with the environment, and the double efficiency of technique and strategy adjustments.

He manages his pace only with his body sensations: *"I am using my brain and it prevents me from acting… I do not have good sensations, I am not paying enough attention to myself, I have no pace and shooting is not that obvious" (7)*; *"I have a good gliding sensation, the pace is good, and I am efficient" (10).*

4. Discussion

The results show that the spearfisher constantly adjusts his activity to perform and to be safe thanks to specific organization during apneas. Four main ideas are discussed: the existence of a safety–performance coupling; that movement and pace are a guarantee of this safety–performance coupling; the development of the sensorial experience as connected with nature's elements; and the development of specific skills and environmental knowledge.

4.1. Safety–Performance Coupling

In any risky activity, safety is an integral part of performance. Performance exists if the diver achieves good apneas and he is still alive. It is particularly difficult to separate both during the action. The spearfisher's actions correspond alternately to safety–performance objectives. Whereas previous studies showed an incompatibility or confusion between safety and productive objectives (Caroly & Weill Fassina, 2004; Gomes et al., 2009), our results indicate that both these objectives are alternately present during a short period of apnea (about 1'30). The spearfisher has safety intentions, performance intentions, and then returns to his safety intentions again during an apnea.

Moreover, results indicate a brisk switch of intentions during the critical period (the stabilization phase). If at the beginning of the stabilization step his intention is to hunt the fish, he quickly switches into safety-intention mode when he sees that he will be too late to get the fish. When the spearfisher detects that there will be difficulties in catching the fish, we observe a switch in his intentions. He thus decides to go (or not) near to the limit of a viable apnea zone. This attitude has been observed when the spearfisher was in difficulties during the apnea. This phase could be considered as the critical phase of the apnea, when danger is perhaps greatest, because of his trade-off obligation; i.e., that the risks incurred could be higher during the stabilization period due to the increased interaction with the fish, which are also in motion. Our results show that safety and performance are articulated thanks to quick intention alternation occurring several times over a short period.

The dilemma is not safety in favor of, or against performance, but to consider both at the same time and to understand the real activity. In order to achieve safety–performance objectives, operators have to confront permanent changes, even more so in risky environments, as has been demonstrated previously (Reason, 1990). Thus, the safety intention might arise from a specific situation, and more particularly during the critical period. We can conclude that dynamic intention exists during action. The objectives during the action change very quickly, and the changes lead to both safety and performance.

4.2. The Movement and the Pace, Guarantee of the Safety–Performance Coupling

The results indicate that in a static situation the pace is broken and the spearfisher hesitates (as indicated by the example of stabilization during the critical period). The results demonstrate a link between intention alternation and pace: when the first intention is followed, the spearfisher keeps pace with the environment. When he has to change his first intention, the ability to remain at pace with nature is disrupted. He is thus in a physically and mentally static position (stabilization period). In football, goalkeepers' pace and static position have been shown as determinant in their performance during critical situations (Villemain & Hauw, 2014). This point has also been highlighted in polar research as a determinant in managing critical situations (Villemain & Godon, 2017). The same phenomenon seems to be true here.

4.3. Sensorial Experience Development

The diver uses his sensory experience to manage both risks and performance. This dynamic, rhythmic, harmonious, fluid interplay between an extreme sport and nature has also been explored in surfing (Brymer & Gray, 2009; Olsen, 2001). The authors likened the interaction between surfers and the environment to a dance between partners. The connection with nature occurs in the movements of the athletic activity itself and seems to be a determinant in safety–performance management. This connection could correspond to the flow concept (Csikszentmihalyi, 1991) in which the spearfisher (physically and mentally) is in fusion with the environment. Actions and situations occur in a dynamic and circular relationship and correspond to the emergence of actor's significations. Spearfishing activity cannot be reduced to pre-established plans or to task prescriptions to guarantee safety or performance. Safety is organized according to a meaningful construction process in a given situation from the activity dynamics in the immediate local circumstances. Safety management depends both on the diver's dynamic environment perception and on his pace. The diver experiencing the situation perceives this situation as risky, and the answer to the risk corresponds to a temporal answer depending only on the situation's conditions. Our results concur with Hollnagel and Woods' (2006) discussion of situation awareness as an important factor for the safety–performance trade-off evaluation. Here, the organization of a diver's meaningful activity *in situ* is totally undetermined before the apnea, and a variety of situations leads the diver to develop sensorial experience and expertise. He therefore uses techniques involving his sensations in order to guide his actions according to the situation. The diver's preoccupation with sensations and his awareness enable him to reach fluidity, freedom of action and mind, and are translated into a pace in accordance with the environment. Action flexibility results from this fluidity and contributes to the realization of both performance and safety.

4.4. Specific Competencies and Environment Knowledge

Studies which deal with extreme sports and risks have mainly focused on risk, and particularly on its negative effects. More recently, studies have indicated the possibility of positive effects of risky activity. Such effects are associated with psychological aspects such as self-confidence, elation, pride, personal challenge, and the sensation of

power, but equally the capacity to remain calm after having experienced fear (Brymer, 2009; Wiersma, 2014). The current study shows that an extreme environment could lead to the development of specific skills such as the ability to manage risks, or to manage the safety–performance relationship. The spearfisher's resources depend on his knowledge of the environment, allowing him to adjust his actions or strategies in order to control the situation. It is clear that he uses risk in interaction with his knowledge and technique in order to develop skills or know-how.

Thus, more than the ability to remain calm in the presence of fear (Brymer, 2009) or to switch from panic to calm at various phases of surfing (Wiersma, 2014), the present results indicate that what is at stake is the ability to develop new competencies, and particularly those related to safety–performance management. Research conducted in a polar environment shows that raiders who experience risky situations develop specific risk management competencies (Villemain & Godon, 2015), thanks to organization particularities, which leave the room for manoeuver to guarantee operators' safety, but equally, thanks to perpetual movement, the capacity to face unexpected events (Villemain & Godon, 2017).

5. Conclusion

5.1 Risky Situations: Does This Environment Facilitate the Development of Self-Knowledge?

The aim of the article was to understand safety–performance articulation in an extreme sport, such as spearfishing. We questioned the spearfisher's performance strategies. Our results indicated that dancing with fish was a strategy to both perform and remain alive, through achieving harmony with the environment. The spearfisher is guided during his actions by his sensorial experience and his feelings in order to know what to do and how to do it. Finally, there is no predominance of one over the other (in the safety–performance dyad) but, instead, a coupling which embodies and incorporates both safety and performance.

The presence of risk creates the impulse to draw on internal resources. The constructive concept of the "enabling environment" (Falzon, 2015) corresponds to the creation of an environment in which people can develop their full potential and lead productive and creative lives in accordance with their needs and interests. A study on the polar context showed that, when confronted with a hostile environment, the autonomy which operators enjoy to find an acceptable solution enables them to develop new skills, thanks to room for manoeuver (Villemain & Godon, 2015; Villemain & Lémonie, 2014). In any risky activity, trade management between performance and safety is a real challenge and depends on learning and competence development. The diver's autonomy is therefore necessary to preserve his life. Other studies have demonstrated the necessity of operator autonomy to assume safety and the importance of allowing for system flexibility (Amalberti, 2007).

Safety is dynamically managed by responding to critical or well-known situations and by temporizing response to situations. Safety is thus organized during the activity and not prior to it, either immediately, or over a short period of time.

The extreme sport experience offers a particular environment in which the participant is connected with nature and can also enhance his/her well-being (Schultz, 2002). However, these are not its only features. It can be a way to develop new competencies and specific risk-management skills, as suggested by the enabling environment approach. Thanks to environmental constraints and his autonomy, the athlete can use the environment to facilitate self-development. Reconnecting with the natural world also plays a major role in the development of global environment care.

The development of a reflexive activity around the sensorial experience of the athlete, and the questioning of past situations and feelings seems to be a gateway to improve safety–performance coupling. The will to control situations in sport fields is pregnant with possibilities and leads actors to excessively rationalize their actions and performance, as can be observed. But such a reading seems very reductionist and simplistic, and does not take environmental complexity into account.

This leads us to question decision making in a real risky context, as developed in the situation awareness model. Our results indicated the predominance of sensorial experience to manage safety–performance coupling, focused on pace and harmony with the environment. This point could link to distributed situation awareness, stipulating that the decision is distributed between the actor and non-human agents (kit for example), the actor and human agents (other operators for example), and the human and non-human agents (Salmon & Stanton, 2013; Salmon, Stanton, Walker, & Jenkins, 2009; Stanton et al., 2006). Distributed situation awareness allows for better understanding of decisions in complex socio-technical systems and is focused on a nonlinear causality. The recording of spearfishing verbatim showed sensorial functioning during the successful situation and more rational/observational functioning during the failed situation. This research highlights the necessity for developing sensorial experience to guide the action and not necessarily the development of rational aspects with observable criteria in risky physical activity.

There are several statements that must be made regarding the limitations of the current study. Firstly, the spearfisher himself specifically chose apneas on which he would be interviewed, in relation to his extensive experience. The apneas may have various characteristics and be integrated differently in his experience. Secondly, as Willig (2008)

noticed, the label "extreme sport" is applied to a variety of activities. Even if there are numerous common points, they also differ in important ways. Researchers need to be careful about depending on generalizations concerning various sports, while trying to understand one sport. Moreover, as previously mentioned, the current research is a case study with only one elite participant. Despite the case study method and data triangulation, no generalizations may be made and we have to consider these results with prudence.

The inconsistency in findings may have to do with the difference in the interview questions used with each apnea studied. In the current study the participant was asked a single question to describe his experience related to safety–performance management, while Partington et al. (2009), for example, asked specific questions related to the risks and benefits that surfers derived from their activity. Moreover, we can add that it would be judicious to lead other self-confrontation interviews, even if it is difficult to record apnea at 30 meters deep or more.

Despite these limitations, this study has the merit of trying to understand a complex phenomenon: safety–performance articulation in a real-world setting with respect to the spearfisher's experiences. Extreme sports take place in complex environments and it would be wrong to separate performance from safety. Both safety and performance have to be studied as well as improved together and not separately. Moreover, performing in any risky environment requires a complex understanding of both the performer's own abilities and the challenges of the activity itself (Willig, 2008).

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