

Situation Awareness: A Pivotal Process for Sensemaking and Decision Making in the Learning and Practice of Physical Activities

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In physical education (PE), reflection on action is usually referred to in relation with pedagogical approaches such as experiential learning, constructivism and social constructivism. In organization systems, sensemaking has been discussed in relation with situation awareness (SA), a construct closely related not only to decision making but to understanding as well. In recent years, researchers interested in decision making in high-level sport performance have taken an interest in SA. The purpose of this explanatory article is to examine the applicability of the SA construct, including its related DM and sensemaking processes, to the teaching/learning and performing of diverse categories of physical activities such as sports, dance, fitness activities, outdoor activities and leisure activities in general. In a first section, the author distinguishes two types of SA, current SA and reflected SA, in relation with reflection in action and reflection on action. With regard to the involvement of one or several individuals, three SA facets are suggested: primary SA, distributed SA, and socially shared SA. Following a short discussion on the relationship between SA and the data/frame theory, the author examines the process of framing physical activities in view of situation awareness. Finally, the metacognitive side of framing and situation awareness is briefly discussed in terms of individuals who come to select particular observational cues that work better for them.

Keywords: *situation awareness, data/frame theory, sensemaking, decision making, frame building*

Introduction

Since Schön's seminal publication on the reflective practitioner (Schön 1983), there has been on a regular basis numerous publications discussing reflection in and on action applied to different fields of practice, including that of education (e.g., Atkins and Murphy 1994, Bjørke et al. 2022, Donaghy and Morss 2000, Downham and Cushion 2022, Johns and Freshwater 2009, Jung 2012, Larsen et al. 2016, Munby 1989, Somerville and Keeling 2004, Treadwell and Taylor 2017). The field of dance education has given a good deal of attention to students' and practitioners' reflection on action (e.g., Leigh 2017, Orrell 2021, Petsilas et al. 2019). In Physical Education (PE),—learners' reflection on action has been discussed at times (Godbout 2001, Gregg 2013, O'Connor 2019, Treadwell and Taylor 2017, Williams and Wainwright 2016), although most publications have considered reflection as a way of improving the efficiency of professional practice

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or as a part of vocational training (e.g., Crawford et al. 2012, Moon and Lee 2022, Tsangaridou and O'Sullivan 1997). Rather than being discussed in itself, students' reflection has also at times been associated with critical thinking (e.g., Donnelly et al. 1999, Gréhaigne and Godbout 1999, Jones et al. 2023, Pill and SueSee 2017). More than 20 years ago, Godbout (2001, p. 12) stated: "In a way, the teaching/learning process may then be viewed as an encounter between a reflexive teacher and reflexive learners". Nevertheless, despite a seeming shift to a learner-centered paradigm, "... there is consistent research that preservice teachers hold on, or revert, to the conceptions they experienced as school students (Richards et al., 2014)" (Moura et al. 2023, p. 162).

Whether learning to perform a physical activity in a learner-centered context or self-managing its regular practice, individuals need to be aware of the situations they find themselves in if they are to manage appropriately their practice. Physical activity self-management implies reflection in and/or on action. In addition to the case of teachers' practice, reflection on action (RoA), in a learning context, is often associated with processes such as authentic assessment (Zessoules and Gardner 1991), student learning regulation (e.g., Alexander and Murphy 1998, Järvelä et al. 2015) and metacognition or metacognitive awareness (Dinsmore et al. 2008, Helyer 2015, Perkins 1992). In physical education, RoA is usually referred to in relation with pedagogical approaches such as experiential learning, constructivism and social constructivism. However, for reflection to be efficient, concerned individuals need a proper and informed perception of the reality encountered.

A construct labeled 'situation awareness' (SA) was developed, in particular, by Endsley (1995, 2015) in relation with incidents- or crises-related working duties (aviation, military, energy production, medicine, etc.). The SA construct relates to an individual's level of consciousness of the particular situation he is involved in, given that the situation calls for some action based on this individual's decision. The efficiency of one's SA is particularly critical in time-constrained situations with potential serious repercussions. As well explained in Endsley's model (1995, p. 36), SA is defined as made of three hierarchical levels: "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future". These three levels lead to decision and action. It follows that SA naturally relates to decision making (DM) (Endsley, 1995), a process that has been discussed on several occasions with regard to high performance in sports (e.g., Ashford et al. 2021a, 2021b, Macquet 2016) but also with regard to the teaching of team sports in Physical Education (e.g., Godbout and Gréhaigne 2022, Gréhaigne et al. 2005, McBride and Xiang 2004, O'Connor et al. 2017).

Another construct labeled 'sensemaking' (see Author's note 1) was developed with a focus on how individuals work, the purpose being to make sense of the information and situations in which they find themselves, largely at the organizational level, with respect to explaining organizational accidents or unusual events (Brown et al. 2015, Endsley 2015). As stated by Klein et al. (2007, p. 114), sensemaking is "the deliberate effort to understand events. It is typically triggered by unexpected changes or other surprises that make us doubt our prior understanding". In other words, sensemaking relates to how people interact with

information and make sense of a problem situation, how they proceed to understand narratives or processes. Sensemaking has been discussed with regard to various areas of education (e.g., Biccard 2018, Fitzgerald and Palincsar 2019, Lim et al. 2019, Odden and Russ 2019). To the author's knowledge, with the exception of a few recent publications by Macquet (2016), Macquet and Kragba (2015), and Rönnqvist et al. (2019), sensemaking as such has not been largely discussed in relation with the learning or practice of sports and other non-utilitarian physical activities (see author's note 2).

The purpose of this explanatory article is to examine the applicability of the situation-awareness construct, including its related decision-making and sensemaking processes, to the teaching/learning and performing of diverse categories of physical activities such as sports, dance, fitness activities, outdoor activities and leisure activities in general.

Situation Awareness, Decision Making and Sensemaking

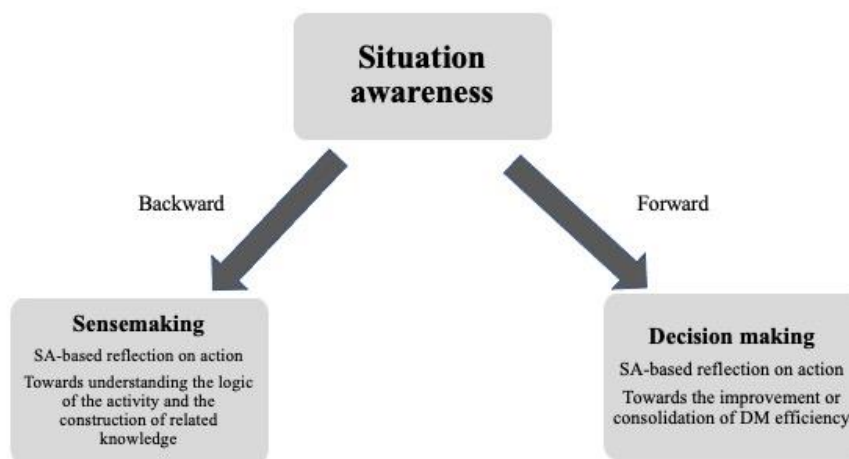
In this article, it is implied that SA refers to individuals' consciousness of their purposeful rapport with their physical and social (if involving several people) surroundings. Alluding to a 'purposeful rapport' means that the person's experience of the situation goes beyond a simple perception of that person's environment. For instance, with regard to visual perception, SA would go beyond seeing or looking; it would rely on informed observation. In other instances where sounds, smells or some other sense would be thought critical, the same upgrading of perception would apply.

In the unfolding of events, an individual's SA is a dynamical process as one's mind continuously adapts to the changing reality. Referring to this dynamic dimension, with regard to invasion team sports, Godbout and Gréhaigne (2022, p. 71) have used the term "*Current Situation Awareness*" (CSA). "The dynamic SA players and, to a lesser extent, teammates-observers are involved with may be analogically compared to a car driver's SA as this individual keeps constantly glancing around, keeping informed of the dynamic environment and ready to take action if and when appropriate". Godbout and Gréhaigne (2022) have also suggested the term "*Reflected (Deferred) Situation Awareness*" (RSA) to designate a person's reflection on a prior SA. While a performer's CSA (see author's note 3) would serve as a basis for reflection *in action*, RSA would contribute to reflection *on action*. With regard to the individual(s) concerned with either CSA or RSA, one may consider facets that Godbout and Gréhaigne (2022) have designated as:

- primary SA (experienced by the individual directly involved in the action);
- distributed SA (independently experienced by observers and communicated to the decision maker[s]);
- socially shared SA (experienced by a group of individuals involved in the action and who have developed common frames of reference).

Although SA has been particularly discussed in relation with DM in sport activities, it may, in fact, be looked at from two perspectives, that of DM and that of sensemaking, and support reflection on action in both cases (see Figure 1). The relationship between SA and DM in sports, particularly in invasion team sports, has been discussed recently by Godbout and Gréhaigne (2022); in this case, SA-based reflection on action, or RSA, focuses on the improvement or consolidation of the learners' or performers' DM efficiency. Another perspective little explored in physical activity practice (PAP) is the relationship between SA and sensemaking; in this case, reflection on action, or RSA, focuses on understanding the logic of the activity and the construction of related knowledge, a process that will be discussed in the following section in relation with the data/frame theory.

Figure 1. *Decision Making and Sensemaking: Two Potential Follow-ups of Situation Awareness*



Situation Awareness and Data/Frame Theory

Individuals' attentional (perceptual and cognitive) limitations have been evoked or discussed by several authors (e.g., Holgado 2011, Macquet 2016, Miller 1956, Ochanine 1978, Stanton et al. 2001) and it is generally agreed that experts base their decisions on less and better focused clues than novices (Herbig and Glöckner 2009, Stevenson 2013, Ashford et al. 2021b). After reviewing 16 information processing studies in relation with DM, Ashford et al. (2021b) reported that players' DM involves the possession of specific key perceptual–cognitive skills such as: "the utilization of domain knowledge in perceiving informational cues ...; (b) the identification of global, salient and predictive cues ...; (c) rapid retrieval of knowledge from memory representations ...; (d) option generation ...; and (e) the role of intuition in the form of the take the first heuristic ..." (p. 12). Thus, it appears that learners' challenge for developing an efficient SA

is to rely on frames of reference based on the most reliable situational structure(s) of the activity at hand, meaning structures that offer, with a minimum of possible relations, the maximum relevant information on situations encountered.

Data-Frame Theory of Sensemaking and Sensemaking Processes

As alluded to earlier, sensemaking (or making sense of) relates to a cognitive process through which individuals come to understand the unfolding of previous events that led to a given situation they are faced with. Sensemaking "involves knowledge construction from information and gaining understanding of a problem-situation" (Pontis and Blandford 2015, p. 842). Sensemaking may thus lead to the understanding of the logic of a given physical activity considering different dimensions of its dynamics (personal, social, temporal, situational, environmental).

Klein et al. (2007) identified the sensemaking structure as '*data-frame theory of sensemaking*'. "The data-frame (D/F) theory postulates that elements are explained when they are fitted into a structure that links them to other elements. We use the term *frame* to denote an explanatory structure that defines entities by describing their relationship to other entities ... [and guides] the search for more data" (Klein et al. 2007, p. 118). According to these authors, it is possible to differentiate several types or mental processes of sensemaking. At the time of their 2007 publication, Klein and his collaborators had identified seven such processes operating in different ways: (1) mapping data and frame; (2) elaborating a frame; (3) questioning a frame; (4) preserving a frame; (5) comparing frames; (6) re-framing; (7) constructing or finding a frame. The purpose of this article is not to review extensively the development of the D/F theory but to consider how elements of that theory may enrich the way we envision the teaching/learning of various physical activities in PE. Readers interested in investigating further the development of the theory may consult, for instance, Pontis and Blandford (2015), Klein et al. (2006a, 2006b), and Moore and Hoffman (2011).

When considering D/F theory, what comes to mind is the connection that can be made with two fundamental constructs of constructivism, namely *assimilation* and *accommodation*. For Klein et al. (2007, p. 134), "the cycle of elaborating the frame and preserving it in the face of inconsistent data is akin to Piaget's (1952) function of assimilation. The process of reframing is akin to accommodation". As expressed by Macquet and Kragba (2015, p. 346), "sense-making pertains to a double cycle comprising two steps: building the frame (i.e., framing) and maintaining it, with reference to Piaget's concept of assimilation, and reconsidering the frame and enriching it by new information (i.e., reframing), with reference to Piaget's concept of accommodation". Table 1 presents the association the author of the present article makes between the seven cognitive processes involved in the Data/Frame model (Klein et al. 2007, Pontis and Blandford 2015) and Piaget's *assimilation* and *accommodation* constructs.

Table 1. *Seven Cognitive Processes Involved in the Data/Frame Model (Klein et al. 2007, Pontis and Blandford 2015) and Relationship with the Constructs Assimilation and Accommodation*

Assimilation	Accommodation
Assimilation occurs when a learner receives new information or perceives a new situation and manages to fit that information or reality into an already existing mental schema (Godbout and Gréhaigne 2021).	Accommodation occurs when a learner transforms a pre-existing mental schema in order to take into account dissonant perceptions of reality (Godbout and Gréhaigne 2021).
	1- Mapping data and frame: involves connecting the data and a frame. Depends on the data and information that is available, and on an individual's aims, repertoire of frames, and attitude.
2- Elaborating (expanding) a frame: one explores an initial frame, searching to add details and fill in slots, thus expanding it.	
	3- Questioning a frame: If, while working with the frame, one encounters data inconsistent with that frame, one may decide that that frame needs to be replaced without being certain whether the frame is incorrect or not (see #4)
4- Preserving a frame*: When inconsistencies previously found are considered not relevant or strong enough to dismiss the frame one has been working with, that frame is preserved.	
5- Comparing frames: In some cases, several frames may be considered at the same time; those frames may be compared to fully appreciate the dimension of the task. According to Klein et al. (2007), individuals can work with a maximum of three alternative frames at the same time.	
	6- Reframing: When one accumulates inconsistencies and contradictory evidence, one needs to replace the frame. In some cases, data elements previously discarded for a frame may be found relevant in a new frame as new cues emerge.
	7- Constructing or finding a frame: When one encounters a situation that does not make sense, or the initial frame cannot be reframed, one seeks and constructs a new frame.

* This process may also be associated with the notion of 'adaptation'. Adaptation represents a state of balance between assimilation and accommodation, a phase when the reality perceived, whatever its variations, fits into the learner's mental scheme (Piaget 1962). "Sensemaking usually ceases when the data and frame are brought into congruence" (Klein et al. 2007, p. 126).

In the French literature, Ochanine (1978) offered the concepts of cognitive representation (*image cognitive*) and operative representation (*image opérative*) (Holgado 2011). The cognitive representation reflects objects in all the diversities of their accessible properties. For its part, the *operative representation* (or representation in action) relates to selected properties likely to ensure the best task

result (see author's note 4). The operative representation is considered to be a reflection of the *operative structure*, that is the most reliable structure of the object for a given task, meaning the structure that offers, with a minimum of possible relations, the maximum relevant information on the object (Holgado 2011). In this article, the author will consider that as an explanatory structure, a frame is similar to an operative structure progressively enriched by new elements that fit the frame. Other authors may refer to schema or data-structure to designate such explanatory structures (Pontis and Blandford 2015), or to mental models (Ellis et al. 2014). According to Klein et al. (2007), frames may be developed based on contexts such as, for instance, "a story (explaining a chronology of events), a map (explaining location, showing distances and directions), a script (explaining roles), or a plan (describing a sequence of intended actions)" (Pontis and Blandford 2015, p. 843).

In relation with D/F theory, Klein et al. (2007, p. 119) saw sensemaking as "a process of framing and reframing, of fitting data into a frame that helps us filter and interpret the data while testing and improving the frame and cyclically moving forward to further adapt the frame". For Endsley (2015, p. 18), as illustrated earlier in Figure 1, "sensemaking is generally backward looking ... it focuses on forming reasons for past events and diagnosing the causative factors for observed faults".

Sensemaking in Relation with Physical Activity

Although originally developed with a focus on ergonomic problems in organizations (Weick 1995), sensemaking has drawn the attention of researchers in the area of decision making in sport organizations (e.g., Alder 2015, Bentzen et al. 2020, Djaballah et al. 2017, Verweel 2006, Wegner et al. 2019). Given the relationship between sensemaking and decision making and the fact that understanding and decision making are key processes in any sport performance, sensemaking was bound to draw the attention of researchers in relation with decision making by athletes and/or coaches in high-level-performance contexts (e.g., Alder 2016, Macquet 2016, Macquet and Kragba 2015). The link was established particularly through a key construct related both to sensemaking and decision making, that of *situation awareness* (Endsley 1995, 2015, Klein et al. 2007, Macquet 2016). As early as 2004, as far as the author can see, there was a publication formally targeting SA in relation with sport (James and Patrick 2004). In an overview of their chapter, these authors wrote: "Given the paucity of research that investigates the role of SA in sport, this chapter will concentrate on the various paradigms that have been used to study it, primarily perceptual processes and anticipation, all of which are in scope to SA" (p. 298). Thereafter, other publications followed, fueled by the seminal publications of Endsley and Klein et al. (e.g., Caserta and Singer 2007, Huffman et al. 2022, Macquet and Stanton 2014, Murray et al. 2018, Schei and Giske 2020).

Despite this association with sports, SA, as related to decision making and sensemaking, may and should be connected with a much larger spectrum of physical activities as will be discussed in the following section.

Framing Physical Activities in View of Situation Awareness

The author has written earlier that sensemaking may lead to the understanding of the logic of a given physical activity considering different dimensions of its dynamics (personal, social, temporal, situational, environmental). The personal dimension refers to each performer's permanent or temporary characteristics that may have an influence on the way he or she performs a given PA. The social dimension of a PA dynamics refers to the fact that it involves at least two or more interacting individuals, either partner(s) and/or opponent(s). The temporal dimension refers to the speed of the unfolding of the activity or its duration. The situational dimension refers to the particular configuration of performance individuals find themselves engaged in. Finally, the environmental dimension refers to the physical environment in which the PA concerned is performed, including weather conditions. Variations in these dimensions reflect the diversity of physical activities individuals may encounter during their childhood, adolescence and adulthood as demonstrated by O'Connor et al. (2022) in their expanded classification for games and sports in PE.

Adapting Frames to Diverse Activities

Two characteristics of physical activities that can bear significant consequences for the use of SA are their level of nonlinearity and the degree of time constraints for decision making they impose on performers. On the one hand, the more nonlinear physical activities are, the more unexpected occurrences may cause havoc, calling for a high SA level while linear activities unfold according to expected scenarios. On the other hand, highly time constrained activities offer little time to grasp any given situation and reflect in action (hence the usefulness of RSA) while activities offering little time constraints provide ample time to seize the situation and reflect in action. For instance, invasion team sports such as ice hockey or basketball are fairly representative of highly nonlinear and time constrained activities while taking a walk on familiar grounds or cross country skiing on flat lands would be representative of fairly linear activities with little time constraints for DM. In addition to the logic of activities concerned, other elements such as weather conditions, the physical environment, the appropriateness of equipment, and the level of one's fitness may bring about unexpected and possibly safety-related situations requiring more or less quick decisions and adjustments. Interested readers may consult O'Connor et al. (2022, Table 5) to find examples of tactical questions that can eventually be related to SA with regard to diverse types of PAs. Readers will note that whereas time constraints bear consequences for DM, they do not directly influence sensemaking based on RSA. Also, the less time constraints there are when performing a given activity, the more available time there is for reflection in action.

Readers will remember the author mentioning earlier, in reference to Klein et al. (2007), that frames may be developed based on a map, a story, a script or a plan. As an example, in invasion team sports, this could analogically translate into cues related to the use of space and time on the court (map), critical incidents

(stories), the distribution of roles among student-players depending upon both teams' competency network (script), or strategic action plans (plan). The same reasoning may be applied with most physical activities included in the PE curriculum or selected on a free basis by students and adults in their everyday life. Targeted frames may concern the technical or tactical aspects of PAs performed, their safety-related aspects with regard to the environment, the weather, or proper equipment and clothing, etc. The safety-related aspects, for instance, would seem particularly appropriate in situations of outdoor or adventure education (Boyes et al. 2019, Sutherland and Legge 2016, Williams and Wainwright 2016). As students' sensemaking develops, the number of frames stored in their memory increases. Based on their studies, Klein et al. (2007, p. 126) stated that "Experts reason the same way as novices, but have a richer repertoire of frames". One might add that their frames may be better structured in terms of cue selection (lesser number and better appropriateness). However there appears to be a limit to the number of frames that can be considered at the same time. According to Klein et al. (2007, p. 140), "people may track two or three frames simultaneously, but rarely more than three". Targeting the right cues may be the key to efficient SA.

There is no single way for an individual or a group to develop, enrich, maintain or modify a frame, or reference mental model, on which lean or uphold SA. Klein et al. (2007, pp. 122-123) stated that "the frame is inferred from a few key anchors, ... These anchors elicit the initial frame, and we use that frame to search for more data elements". Thus, although initially based on selected meaningful key anchors, the frame is a dynamic operative structure that may be enriched as experiences cumulate and provide additional meaningful cues. As long as new data fit with the frame, new knowledge is assimilated. Otherwise, the frame is questioned, re-examined and modified through accommodation. We have seen earlier that Klein et al. identified several cognitive processes that lead to the development, selection, adjustment or rejection of frames (Table 1). Distinctions among these processes, as presented by Klein et al., make more explicit actual circumstances in which either assimilation or accommodation is at work and help understand that (a) frame development is a dynamic process and (b) as motor skills improve and DM procedural knowledge increases, different frames initially rejected may prove to be useful.

Helping Learners Build Significant Frames

There might be a 'chicken-and-egg' paradox in the initial selection of key anchors for a given frame at the time students have little experience with a given activity. For instance, Pontis and Blandford (2015) conducted a study to explore how academics construct knowledge of their community through building an understanding of the concept of influence (being influential and becoming influential) and what sensemaking activities or processes (see Table 1) they undertake while making sense of that community. Discussing whether there is an order in which cognitive processes of sensemaking are initiated, Pontis and Blandford (2015, p. 857) stated "Building an understanding which leads to the construction of an explanatory structure emerged as an essential initial activity or

starting point for making sense of a structure task. „, participants could not start the [sensemaking] process until they managed to construct an explanatory structure".

Prior to learners' formulation and selection of initial key anchors, divergent questioning by the teacher should initiate the former's tactical thinking process, helping them construct a few basic action rules and management rules (e.g., see Gréhaigne et al. 2005 for action rules and play organization rules in invasion team sports; see also Godbout 2021b for exercise-monitoring procedures and exercise-management rules). Determining key anchors rests on one's understanding of what is at stake during the practice of the activity and what SA should focus on (e.g., Gregg 2013, Mercê et al. 2021). In that respect, problem-based (Ryan 2021) or project-based (Simonton et al. 2020) learning approaches would seem most appropriate, providing learners with opportunities for reflecting on SA-related cue selection given conditions of learning or conditions of practice (see the PA dimensions mentioned earlier). Faced with a problem to solve or a project to conduct, learners are challenged to resort to divergent and strategic thinking when targeting a particular aspect of the activity and selecting cues to be included in that frame.

Metacognitive Side of Framing and Situation Awareness

Considering what has been written in this paper so far, it should now be obvious to readers that the data/frame theory involves a constructivist approach to sensemaking. Students' or performers' participant progressive elaboration of efficient frames may thus be associated with metacognitive processes as these individuals come to select particular observational cues that work better for them in terms of SA. Discussing metacognitive awareness and self-regulation in the learning of team sports, Godbout and Gréhaigne (2020, p. 441) wrote: "For students, experiencing metacognitive awareness means knowing about their own thinking. Knowledge of cognition concerns an awareness of one's strengths and weaknesses, knowledge about strategies and why and when to use those strategies". Perkins' (1992) categorization of metacognitive learners (tacit, aware, strategic, and reflective learners) may be considered in terms of their progress framing-wise. Analogously, *tacit framers* would not think about any particular key anchors or observational cues, seeing situations as they come and making the best of them. *Aware framers* would notice some aspects of a situation as positive or negative without being proactive about it and looking for such occurrences. *Strategic framers* would organize their framing by using problem solving, grouping and classifying cues, seeking evidence and making framing choices. In a sense, they would be using some of the processes listed previously in Table 1. Finally, *reflective framers*, beyond being strategic about their framing, would also reflect upon their framing success or failure, taking notice of their effective or ineffective SA and making adjustments accordingly (questioning a frame, preserving a frame or reframing). In that respect, the choice of frame components might vary from one learner to the other depending upon their sensitiveness to one cue over another. For a more extensive discussion on metacognitive awareness and

self-regulation of learning, readers may consult Godbout and Gréhaigne (2020, pp. 441-443).

Beyond the effectiveness of particular frames in term of selected cues, the matter of the breadth or comprehensiveness of frame selection should also be considered as mentioned before. Whereas tacit or aware framers could be lured into considering only the motor and/or tactical requirements of the activity per se, strategic and reflective framers would consider a wider spectrum of cues based not only on the internal logic of the activity but on the logistics of its practice as well (equipment, physical environment, weather conditions, safety measures, etc.).

Situation Awareness and Performance Appreciation

So far, this article has been devoted to decision making and sensemaking as they may apply to learners and users with regard to physical activities. In a recent publication, Godbout (2021a) argued that physical literacy encompasses physical performance appreciation. He wrote:

an individual's rapport with PA may be looked at from a performing point of view, in terms of PA practice, and from an observing point of view, in terms of PA-performance appreciation. As is the case for the performing aspect, such an appreciation draws on the intellectual, psychological and social development of a person and, inversely, has an impact on it. One's performance appreciation capacity may vary from the fan stage to one of a connoisseur and ultimately one of expert-analyst. Each stage will require a corresponding level of PL-related language and PL-related intelligence. (p. 9)

Although SA has been at this point examined with regard to reflection in/on action, one should not overlook the fact that physical performance may be observed not only by student observers in a learning context and by teammates in a context of team activities, but also by bystanders or spectators. The construct of distributed SA mentioned earlier may be evoked in relation with reflection on action in a learning context involving partners who observed teammates' performance and provide augmented feedback (see Godbout and Gréhaigne 2021, p. 50, for a discussion on student observation). In addition, progressively learning how and what to observe in performance situations may be seen as a prelude to the experience of performance appreciation as spectator. The better prepared in term of situation awareness, the better one can eventually appreciate PA performances as a fan, a connoisseur or ultimately an expert-analyst. Although not a priority objective in itself in a PE context at school, one cannot ignore the importance of priming high-school students and, where appropriate, college students for an informed appreciation of others' physical performances throughout their adulthood.

Conclusion

This article has discussed situation awareness as a key process for decision making, sensemaking and understanding in relation with any physical activities undertaken by learners and physically active adults. Knowledge and understanding, as by-products of sensemaking, remain two fundamental attributes that characterize physically-educated, or physical-activity literate, individuals. Becoming self-directing, self-actualizing and self-regulating in terms of one's physical-activity practice implies regular reflection in and/or reflection on action on the part of learners and active adults as well. The efficiency of that reflection relies in good part on the quality of the information provided by each individual's SA and its related frames.

Author's Note 1

Whereas some authors (e.g., Klein et al. 2007, Weick 1995) use the term sensemaking, others (e.g., Dervin 1998) use the written version 'sense-making'. Weick (1995, p. 4) defined the term as "the making of sense". For their part, Brown et al. (2015, p. 266) wrote: "There is, though, an emergent consensus that sensemaking refers generally to those processes by which people seek plausibly to understand ambiguous, equivocal or confusing issues or events". In this article, we will use 'sensemaking' as it is associated with the data/frame theory.

Author's Note 2

The term 'non-utilitarian' refers to these categories of physical activities usually not related to the work force. Activities concerned relate to physical education, fitness, recreation, high performance and dance. By extension, activities of professional athletes, dancers and other high performers may also be included.

Author's Note 3

Throughout the paper, the term 'performer' refers to an individual executing or carrying out a physical activity. Thus, in the context of the article, it does not refer to high performance as such; it rather designates a student in a learning context or a person involved in some physical activity.

Author's Note 4

For instance, at the time of a counterattack in an invasion-team-sport situation, the cognitive representation (*image cognitive*) would include all the perceptual and mental cues accessible to the player who has possession of the ball, including the size of the court, his or her position on the court, the number of players, their

strengths and weaknesses, their location and movement on the court, the agreed-upon strategy, the surrounding noise, and so on. For its part, the operative representation (image opérative) might include selected cues such as the player's position on the court, the position and movements of close opponents and partners, the agreed-upon strategy, and possible target(s) for a safe pass. As the player gets closer to the adverse goal, the operative representation would focus on the goalkeeper, immediate partners and opponents, possible angles of shot and other relevant cues

Acknowledgments

The author wishes to express his thanks to "Professor Luc Nadeau" for his help in the editing of Figure 1.

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