SITUATION AWARENESS IN SPORTS SCIENCE: BEYOND THE COGNITIVE PARADIGM

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Review paper

Abstract
In sports, is increasingly spread awareness that cognitive-perceptual abilities, such as anticipation, decision-making, and awareness of the situation, are prerequisites for excellent performance. Experienced athletes develop, as a result of a long practice, sophisticated task-specific knowledge structures that enable them to deal with situations more effectively and efficiently than others. Elite athletes, for example, selectively perform a visual scan of the scene, focusing the inattention on relevant sources and discarding irrelevant information at the same time. Additionally, experienced athletes are more aware of events that can be probabilistically occurring in a given situation and are able to capture contextual signals that can facilitate predicting future events. These skills act in complementarily with a vast repertoire of strategies and tactics available and with the knowledge of their rapid spendiness in a given situation.

Key words: *enactive, sensomotory system, decision making, elite athletes.*

Introduction

Enactive knowledge is not merely knowledge mediated by the senso-motor system, but knowledge coded in the form of motor responses and acquired in action. For example, this type of knowledge is required in tasks such as driving a car, molding clay, dancing, playing a musical instrument, and it is difficult to represent in iconic or symbolic form. The transmission of this type of knowledge is based on experience and on perceptual responses to motor acts (Morganti, Carassa, & Riva, 2008). In sports, is increasingly spread awareness that cognitive-perceptual abilities, such as anticipation, decision-making, and awareness of the situation, are prerequisites for excellent performance(P.A. Di Tore, Discepolo, & Di Tore, 2013). Experienced athletes develop, as a result of a long practice, sophisticated task-specific knowledge structures that enable them to deal with situations more effectively and efficiently than others. Elite athletes, for example, selectively perform a visual scan of the scene, focusing their attention on relevant sources and discarding irrelevant information at the same time (Altavilla & Raiola, 2014; Raiola, Parisi, Giugno, & Di Tore, 2013). Additionally, experienced athletes are more aware of events that can be probabilistically occurring in a given situation and are able to capture contextual signals that can facilitate predicting future events. These skills act in complementarity with a vast repertoire of strategies and tactics available and with the knowledge of their rapid spendiness in a given situation. According to Aidan Moran, "the study of athletic expertise can shed light on the relationship between knowledge and skilled action in complex dynamic environments that are characterized by uncertainty and time constraints. Specifically, studies in this field can help to identify the cognitive processes and neural mechanisms that underlie expert and novice differences in pattern recognition, decision making (DM), and skilled performance (Tiziana et al 2016, D'Isanto & Di Tore 2016, D'Isanto 2016). For example, research shows that expert athletes are generally superior to novices in recognizing and recalling precise details of patterns of play in their specialist sport—a skill that enhances their "situational awareness" (SA) (or their general understanding of what is going on around them) and efficiency of performance" (Moran, 2014). The concept of Situation Awareness is a key concept in activities in which cognitive and physical tasks are being performed in a complex system consisting of multiple humans and artifacts, under quickly changing conditions (Salmon, Stanton, Gibbon, Jenkins, & Walker, 2009). The concept of Situation Awareness (SA) was introduced by sport psychology in the 1970s, generally related to team sports. The scientific works produced during this period, predominantly of theoretical arguments, concern stimulus-response theory, perceptual signals and attentive style (Nideffer, 1976). In the sports field, the concept was resumed, at a later date, by Patrick, James, Ahmed, and Halliday, who in a study on the assessment of Situation Awareness in team sports (Raiola 2014ab,) have listed the essential dimensions of SA, identifying them in planning, problem solving, team coordination, attention, communication and knowledge (Patrick, James, Ahmed, & Halliday, 2006). More recently, the concept of SA has been applied to a wide area of scientific domains(Hone, Martin, & Ayres, 2006). Situation Awareness, indeed, seems to be a theoretical meeting place for knowledge fields sometimes even distant from one another, from aeronautics to medicine, through the inevitable neuroscience and computer science(Di Tore & Raiola, 2012). "The importance of 'situation awareness' (SA) in assessing and predicting operator competence in complex environments has become increasingly apparent in recent years. It has been widely established that SA is a

contributing factor to many commercial and military accidents and incidents" (Banbury & Tremblay, 2004). This very peculiar nature, which eludes disciplinary fences, makes it difficult to define: "Yet determining exactly what constitutes SA is a very difficult task, given the complexity of the construct itself, and the many different processes involved with its acquisition and maintenance" (Banbury & Tremblay, 2004). By trying to narrow the field, we can state that Situation Awareness covers those activities in which cognitive and physical tasks are performed in a complex system in which individuals and objects interact in conditions of rapid change (Salmon et al., 2009). Situation Awareness and complexity are, then, in close relationship, at least as they are complexity and unpredictability: "Weather is the classic example: many components interacting in complex ways, leading to notorious unpredictability. Ecosystems, for instance, economic entities, developing embryos, and the brain-each is an example of complex dynamics that defy mathematical analysis or simulation" (Lewin, 1999).

Discussion

Situation awareness and complexity

The universally accepted definition of SA is that provided by Endsley (Endsley, 1988). Endley defines SA as «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 (Endsley, 1988). The definition of Endsley refers to a process articulated in the three stages of perception, comprehension, and projection. The perceptual level (1) concerns the collection of relevant environmental information, while the comprehension level (2) "encompasses how people combine, interpret, store, and retain information".

Comprehension level "includes more than perceiving or attending to information, but also the integration of multiple pieces of information and a determination or their relevance to the person's goals" (Endsley, 1988).The last stage of the process, the Projection level (3), involves instead "the ability to project from current events and dynamics to anticipate future events (ad their implications)" and then "allows for timely decision making" (Endsley, 1988).

Endsley explicitly links awareness of the situation to ability "to anticipate future events (ad their implications)" (Endsley, 1988). Situation Awareness, decision making are strictly linked. Awareness of the situation is crucial for timely decision-making, according to Endsley, when the complex nature of the situation does not allow a "linear" analysis. Antonio Damasio informs us, elsewhere, that different types of knowledge (declarative knowledge, inactive knowledge) work in additive and non-alternative ways, and rely on different neural systems: "Deciding advantageously in a complex situation is thought to require overt reasoning on declarative knowledge, namely, on facts pertaining to premises, options for action, and outcomes of actions that embody the pertinent previous experience [...]. Overt reasoning is preceded by a nonconscious biasing step that uses neural systems other than those that support declarative knowledge" (Bechara, Damasio, Tranel, & Damasio, 1997). However, the situation awareness-anticipation link seems to go far beyond the conceptual debt that Endsley pays to the cognitivist paradigm (the perception-comprehension-projection triad seems faithfully reshape the IPO model - input-processing-output) to embrace a vision of the paradigm perception-action that has metabolized the contribution of neuroscience (Pio Alfredo Di Tore, 2015).

Elite athletes, for example, in a situation sport, do not apply linear pre-processing-action schemes, but rely on instant synthesis that immediately selects, among the myriad of available data, those considered significant (Rago et al, 2017, Raiola & D'isanto, 2016ab). We are faced with the "lightning recapitulation of rational processes rooted in the senses, the ability to go from the known to the unknown time on the basis of clues," as wrote Carlo Ginzburg postulating a "circumstantial paradigm"(Ginzburg, 1979). If our brains were forced to process all the information that the perception of the outside world provides them to decide how to act in a certain situation, the task would be too costly and complex to allow for timely decision-making: we would be consistently late and we would not be able at the end to produce effective decisions (Rivoltella, 2014).

Berthoz writes: "the brain solves the complexity of the outside world producing perceptions consistent with the intentions regarding the future, the memory of the past and the laws of the outside world that has internalized"(Berthoz, 2011a).Faced with the complexity, in other words, the brain tries to be one step ahead. "The perception of a form or an object is never passive, it is always a decision.When I look at the objects and forms here, whether the room, your face, your body or objects, my brain does not just analyze it, he decides, he anticipates" (Berthoz, 2011a).

The idea of the perception-action binomial matured in the phenomenological reflection, consolidated in neuroscience research, thinks the two moments of perception and action are not as consecutive and discrete, but with a paradigm reversal, perception is the function of action(Carlomagno et al, 2013).

"The perception does not represent the world, but constitutes it as Umwelt. The action does not just react to the event, she precedes it with simulation or emulation[...] Our notion of action is much richer than current sensorimotor theories that continue to subordinate it to the category of movement" (Berthoz & Petit, 2006). In this perspective, the human brain is not a processor, but an emulator: "Human brain is not an open system […] that accepts inputs from the environment, processes them, and returns them to the world reflexively

regardless of their complexity", but is a "closed system modulated by the senses […] a self-activating system, whose organization is geared toward the generation of intrinsic images, capable of emulating reality (generating emulative representations or images) even in the absence of input from such reality, as occurs in dream states or daydreaming. From this one may draw a very important conclusion. This intrinsic order of function represents the fundamental, core activity of the brain. This core activity may be modified (to a point!) through sensory experience and through the effects of motor activity" (Llinás, 2002).

Conclusion

From this point of view, SA has the function to decipher a complexity approachable in terms of data processing and decision between alternative opportunities. The activity of the body, assumed as a complex system, is characterized by a significant reduction of any pre-established complexity and by the introduction of "simple" accessory complexity linked to the local situation. This "simple" complexity, reduced and recoded in function of action, in a form compatible with its own needs, is, in fact, Situation Awareness.

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