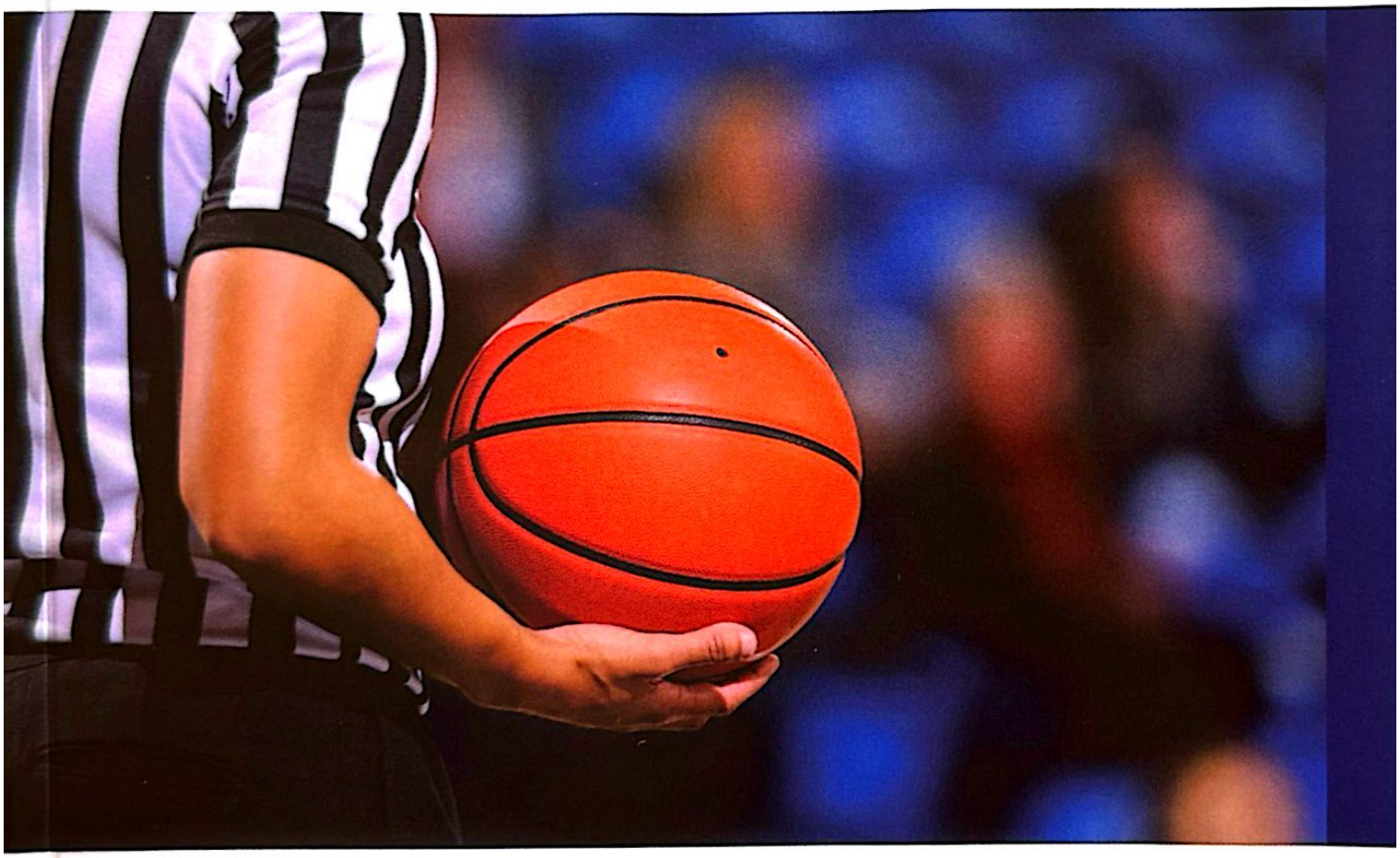
Managing and Developing Sports Officials

Officiating Excellence



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ROUTLEDGE

13

THE ACQUISITION OF PERCEPTUAL-COGNITIVE EXPERTISE IN SPORTS OFFICIALS

Can We Make the Human Brain Smarter and Faste

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Introduction and Literature

In many sports, coaches translate scientific findings into training guidelin to facilitate the acquisition of expert performance. For example, physiolo ical principles are considered when a physical training program is prepare For perceptual-cognitive skills, however, the translation from laborato findings to evidence-based practice in the training field has often bee disregarded, although its importance is acknowledged (Abernethy et al 1998). From a theoretical point of view, the expert performance approac (Ericsson & Smith, 1991) is often used in research on perceptual-cognitiv skills. This approach is characterized by three stages. In the first stage representative tasks are developed either in the laboratory or on the field allowing researchers to capture the essence of expertise, for example, ir assistant referees (e.g., Gilis et al., 2008). In the second stage of the expert performance approach, the underlying mechanisms are identified that mediate expert performance and may explain incorrect decisions in less experienced performers. Various process-tracing measures are used such as eye movements that contribute to explaining incorrect offside decisions (e.g., Catteeuw et al., 2010a). Finally, in the third stage, the learning processes and acquisition of expert performance are examined via training history profiling and training interventions. Both in real life as well as in sports officiating across disciplines, there has been a lack of publications examining the impact of different types of instructional methods that may facilitate and accelerate the acquisition, retention, and transfer of perceptual and cognitive correlates of expert performance (Schorer et al., 2015).

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Originally, Marteniuk (1976) defined perceptual-cognitive skill as the ability of performers to identify and process (environmental) information for integration with existing knowledge to facilitate the selection of appropriate responses under time pressure. Researchers such as Williams et al. (2011) have identified six perceptual-cognitive discriminators that may be equally important for the acquisition of expert performance in players and sports officials.

Expert performers demonstrate a superior ability *to pick up advanced visual cues* from an opponent's or teammate's postural orientation to facilitate situational awareness and anticipation of key events. Second, an important component of expert performance is the ability to detect patterns of play early in their development. This allows performers to read the game in an appropriate way. The experts' superior *pattern recognition ability* has typically been inferred from their superior performance on recognition and recall tasks when compared with novices. Third, elite performers search the scene in a selective way (*visual search behavior*), focusing their attention on relevant rather than irrelevant sources of information. Fourth, beyond the more effective processing of contextual information as the action unfolds, experts can assign accurate *situational probabilities or expectations* to each event that may or may not occur, such that they are able to allocate attention judiciously to the most important contextual cues or clues. As a result, performers learn what to expect. Fifth, all these skills are coupled with an extensive knowledge of strategies and tactics (*strategic decision-making*) and how these may best be implemented in any given situation. Finally, successful performance is dependent on an individual's ability to effectively deal with stress. While researchers have shown that stress can lead to deterioration in perceptual, cognitive, and motor performance, elite performers are less inclined to suffer the negative consequences associated with stress by developing effective emotional control strategies.

Below we provide an example of the application of the expert performance approach in football refereeing (Figure 13.1). In the first step, representative

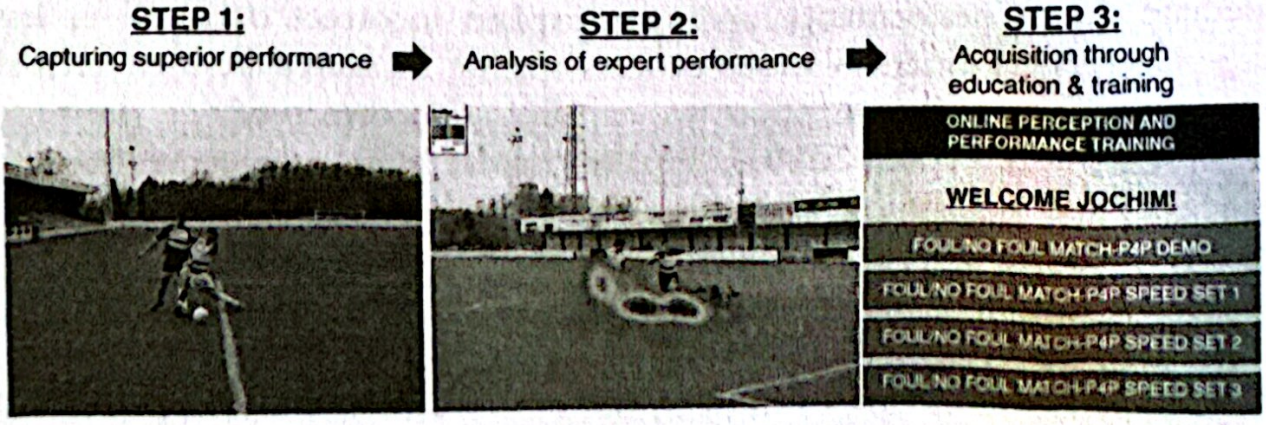

FIGURE 13.1 Use of the expert performance approach in the perceptual-cognitive training.

tasks are produced on-field and off-field to capture the role-specific key expertise. In the second step, eye movements are used to study what information expert performers are looking for compared to intermediates or novices (Spitz et al., 2016). In the third step, both on-field and off-field (or online) training tools are used to expose sports officials to match incidents. Ericsson (2006) considered practice only to be beneficial and effective when it is challenging with respect to its level of difficulty, informative by offering immediate and accurate feedback (slow motion > snapshot > only correct answer), and repetitive with opportunities for gradual and continued improvements (continuous > infrequent > no feedback). With regards to instructional methods (e.g., explicit, implicit, guided discovery, speeded video, video gaming), explicit instruction may result in more rapid improvements during acquisition, while less prescriptive methods (e.g., implicit instruction, guided learning, guided discovery), may result in a performance enhancement during retention.

Sports Officiating is a Practice-Poor Domain

Deliberate practice encompasses specially designed training activities, based on the principles of repetition and successive refinement, to improve specific aspects of an individual's performance (Ericsson, 2006). The required amount of deliberate practice for a given level of skill or expertise can vary significantly, and some aspects of performance might appear unaffected by practice (Baker et al., 2015; Hambrick et al., 2014). For instance, certain aspects of refereeing performance are dependent on more stable psychological traits. Moreover, apart from deliberate practice, other forms of experience may contribute to individual performance differences, including experience from match competitions and play activities (Macnamara et al., 2016). Of course, it is not only about the quantity of practice hours, but also about the quality of education and training. In this respect, refereeing can be considered a "practice-poor" domain for various reasons.

Sports officials are required to have a strong foundation of declarative "rulebook" knowledge. In this respect, training interventions and official education mainly consist of explicit, observational learning, in which an officiating instructor explains why there is a foul and explicitly relates specific visual cues to the criteria in the rules of the competition. In the competitive environment, however, officials need to apply the rules of the competition, and this is referred to as procedural knowledge. There has been a lack of education and training in the procedural decision-making skills of officials. When learning how to swim or how to drive a car, "rulebook" knowledge is not sufficient before going into the water or on the road. Therefore, procedural skills need to be learned carefully and progressively during practice sessions in the real context of the water or

the road. Interestingly, officials seem to learn procedural knowledge only when they officiate a competition. As such, officiating can be considered a "practice-poor domain" because they do not usually practice their technical, tactical, and physical skill in the same way as athletes do. Very often, the competition is a learning context while it should be a performance context. In other words, the stage to perform is at the same time the best moment for training role-specific skills ("learning on the job"), and experience is built on repetition of actual performances (MacMahon et al., 2007). Interestingly, Catteeuw et al. (2009) showed that years of officiating, hours of practice per week, and number of matches officiated were each positively correlated with football refereeing skills. They also observed that international elite referees and assistant referees showed on average 5,325 and 4,987 practice hours, respectively. This equals approximately eight hours of deliberate practice per week.

Another argument to consider sports officiating a "practice-poor domain," is the relatively low number of competitions they officiate and the limited number of crucial and challenging decisions they must take during these competitions. According to Catteeuw et al. (2009), international elite association football referees and assistant referees officiate on average 575 and 652 matches in their 22-year career, respectively. Moreover, there is only limited and delayed feedback on the correctness of their decisions during and after matches. It is therefore questionable whether sports officials really learn from competitions because valid feedback is a prerequisite for learning (Williams & Davids, 1995).

Beyond the mere study of the written rules and experiences acquired throughout competitions, it seems necessary to have accompanying videos to learn rule application (Bar-Eli et al., 2011). In this respect, observational learning refers to the use of video clips with instructors explaining why there is a foul, referring to the criteria in the rules of the competition. While this type of training is valuable, it is not representative of the perceptual-cognitive demands of the competition context. Therefore, other complementary tools will be discussed below to compensate for the practice-poor context by integrating perception, decision-making, and communication into the physical training sessions and the overall instructions given to the sports officials.

Officiating: A Specific Decision-Making Process

In nearly all competitive (team) sports, competition is led by a team of sports officials to protect the safety of the players and penalize violations of the rules from a neutral point of view. Their decisions may also impact the course of a competition and, eventually, the outcome. According to Bar-Eli et al. (2006), awarding a red card has considerable consequences

for the outcome of the game and may also result in substantial economic consequences. In fact, it is a complicated task with huge impacts. Therefore, we cannot tolerate numerous errors from the officials. Unique physical, perceptual, and cognitive skills are required to fulfill this role and to make sure that the underlying decision-making process results in uniform and consistent decisions (Kittel et al., 2021; Larkin et al., 2014).

Media coverage in England (Skysports, 2018) demonstrated that referees take 245 decisions (1 every 22 seconds) with an average of 97.8% decision success. Assistant referees on the other hand were considered to take 60 decisions (1 every 90–100 seconds) with an average of 98.0% decision success rate. In line with the observations of Samuel et al. (2019), referees may be much more involved with respect to perception and decision-making apart from these technical decisions. In fact, the number of activity changes a referee shows during a typical game is about 1,268, or a change in activity every 4 seconds (Castagna et al., 2007). Of these 1,268 activity changes, 588 and 161 are a consequence of low-intensity and high-intensity running match activities, respectively. If we add these numbers to the purely technical decisions of about 200 (Helsen & Bultynck, 2004), then the total number makes 1,468, or a game-related decision every 2.5 (considering an effective playing time of around 60 minutes). Obviously, the decisions of referees are not 100% accurate, and therefore the video assistant referee (VAR) was introduced to correct clear and obvious errors for possible match-changing incidents (Fédération Internationale de Football Association, 2016). Nevertheless, a correct and consistent initial decision of the main referee remains. Moreover, not all decisions can be reviewed, even though they can have an impact on the game dynamics (Spitz et al., 2021).

Video training itself is evaluated as very relevant by international elite referees in association football, but the challenge is to develop video-based training that focuses on key perceptual-cognitive skills of referees, such as handball incidents (Catteeuw et al., 2009). The use of realistic video-based decision-making footage and protocols may be an effective supplementary tool in the selection and training process of referees. A systematic training approach to developing key perceptual-cognitive skills would certainly benefit referee recruitment, education, training, and overall performance. Previously, researchers have indicated that the perceptual-cognitive skills of referees and players can be improved and specialized training and coaching can accelerate their progress (Mascarenhas et al., 2005; Put et al., 2016; Schweizer et al., 2011). In fact, across publications, there appears to be an increase in decision-making accuracy of 10% from pre- to post-test, and of 15% from pre- to retention-test (Figure 13.2).

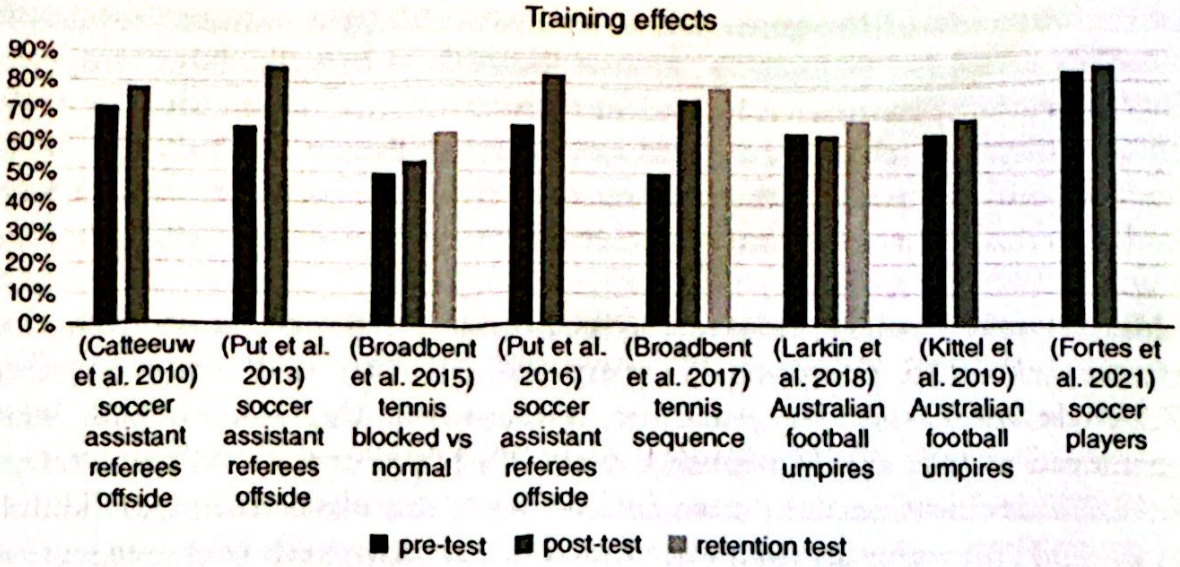

FIGURE 13.2 Training effects indicated a 10% increase in response accuracy from pre- to post-test, with a 15% increase from pre- to retention test. This effect was across disciplines.

Practical Case Study

Background and Context

Our case shows the benefit of using the expert perception and performance approach to improve offside decision-making accuracy. In fact, it started after the FIFA World Cup 2002. Helsen et al. (2006) observed that 26.2% of the flag signals were incorrect. As a result, FIFA's Medical Assessment and Research Centre supported a PhD project to study the underlying mechanisms of incorrect offside decisions and how to improve it.

Presenting Issues

The research we conducted clearly indicated that the perceptual illusion induced by the flash-lag effect (FLE) explained most incorrect offside decisions in real-match situations (Catteeuw et al., 2010b) and laboratory tasks (Gilis et al., 2008). Originally, the FLE refers to a spatially and temporally forward misjudgment of a moving object at an instant defined by a time marker (usually a briefly flashed stimulus). Translated to offside situations in football (Baldo et al., 2002), this means that the attacker receiving the ball (moving object) is perceived ahead of his actual position at the moment of the pass (flash). This illusion results in an overall bias toward flag errors (ARs might raise their flag while the attacker is not in an offside position) in comparison with non-flag errors (ARs do not raise their flag while the attacker is in an offside position). Our research also showed that expertise levels critically depend on the ability to overcome these perceptual-cognitive difficulties (Catteeuw et al., 2010c).

Intervention

Below is a timeline of interventions that were introduced by UEFA with respect to the integration of perception and decision-making into the physical training sessions and the overall instructions given to match officials (Figure 13.3).

In addition to the declarative "rulebook" knowledge and the observational learning that is on the agenda of most refereeing meetings, in 2007 UEFA started to focus on typical offside exercises where players were involved and assistant referees had to make an offside judgment. Thereafter, feedback was provided that consisted of slow motion of the same incident and the still frame. In fact, the same approach was followed in the leadup to UEFA EURO 2012 where additional ARs were introduced. Evidently, this type of exercise is still being continued and also extended to foul incidents acted by players to challenge the teamwork between the referee and the ARs. By experience, we learned that it is crucial to educate the players on how to simulate typical foul incidents in a proper way.

In close cooperation with UEFA, we also produced an online video-based training platform (https://www.perception4perfection.eu) with the objective to (i) provide match officials with more experience in solving typical match incidents and (ii) to improve and fine-tune the perceptual-cognitive skills and, ultimately, the match performance of assistant referees, referees, and VARs. Via this platform, referees have access to specific offside/no offside or foul/no foul situations or VAR incidents, filmed from both an in-game perspective and

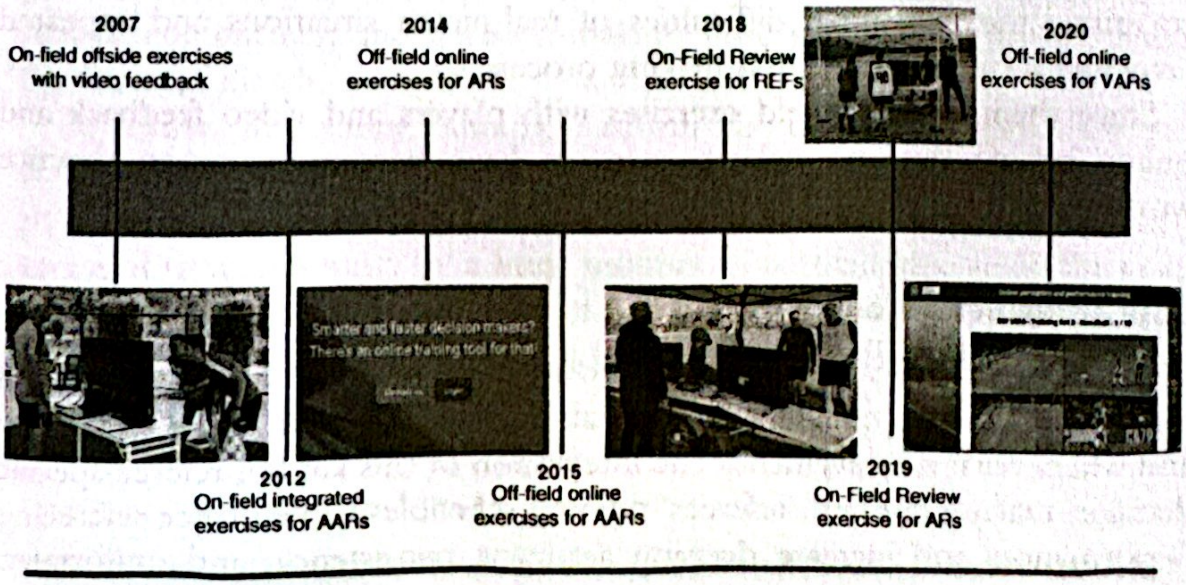

FIGURE 13.3 Timeline of innovations that were introduced by UEFA with respect to the integration of perception and decision-making into the physical training sessions.

high-definition UEFA footage. Referees can log in with their personal email address and password and complete several training sets. A training set usually consists of 20 incidents, and each official receives immediate feedback regarding the correctness of their technical and disciplinary decisions. In addition, the (assistant) referees also receive the slow-motion video of the incident. Referees and VARs are provided with expert comments from UEFA that highlight the various considerations that underpin the thinking process.

In our database, there are almost 2,000 clips containing more than 700 offside situations, 500 VAR-related practice clips, and about 800 referee incidents. During the past season, we have assisted over 700 officials from different national football federations along with a group of 166 UEFA VARs to get match-ready with respect to their perception and decision-making skills. Overall, since we started with our online platform, 73,192 sets of 20 clips each have been completed that gives a figure of almost 1.5 million match incidents our match officials were exposed to (data from May 31, 2023).

Outcome Analysis

Remarkably, during the 2006 World Cup in Germany, the flag errors decreased to 10% which is less than 50% of the errors observed during the 2002 World Cup (Catteeuw et al., 2010b). In addition to the on-field training with players, the online offside decision-making training also contributed substantially to improve the offside decision-making accuracy. In fact, it allowed expert ARs to learn a compensation strategy to overcome the negative outcomes of the FLE (Catteeuw et al., 2010d). A combination of video- and computer-based training with immediate feedback was used to mimic the perceptual difficulties of real-match situations and appeared favorable to improve decision-making processes.

Since then, both on-field exercises with players and video feedback and online offside decision-making exercises have become common practice worldwide.

Case Study Reflections

The format of "distance learning" provides interesting advantages, as it is space- and time-independent: individuals can practice at any time of the day and whenever it is convenient. The integration of this kind of referee-specific decision-making task into referees' training schedules will enhance refereeing performances and increase decision accuracy, consistency, and uniformity. Thanks to COVID-19, this way of training became very convenient because there are no players involved and there is no need for technology and/or manpower. This tool is now commonly used among elite referees and has been introduced at lower levels (Schnyder & Hossner, 2016).

While there are clear benefits, there has been a lack of publications examining the retention and transfer of perceptual and cognitive correlates of expert performance in real life as well as in officiating in sports across disciplines and what the impact is of different types of instructional methods that may facilitate and accelerate their acquisition and retention. As far as we know, there is one study by Put et al. (2013) that revealed a positive transfer of 23.3% from online training to on-field offside decision-making performance. As well, Larkin et al. (2017) also showed the benefits of video-based training to improve perceptual-cognitive decision-making performance of Australian football umpires.

In future, sports officials will be provided the opportunity to practice their perception and decision-making skills in a unique and individualized learning environment (need-dependent). This training tool can also be used in a complementary way to the observational learning that is on the agenda of most refereeing meetings. If, for example, the topic in the classroom is handball, then the on-field review exercises on the field with high-intensity running can also focus on handball as well as the online exercises referees may be exposed to. The combination of high-intensity running with time-constrained decision-making is also recommended to prevent sports choking or analysis paralysis. This refers to a phenomenon where athletes underperform or fail to execute their (decision-making) skills at a critical moment, despite being skilled and capable (Jordet & Hartman, 2008).

Moreover, this online application also offers the possibility to show the ARs, referees, and VARs a limited number of interesting game situations of a previous match day. Using the feedback of the technical experts of the referee committees, the decision-making process becomes further refined for the next match.

Of course, this online training platform also offers possibilities for other actors in the football community, including players, coaches, media, and the public. As there is a huge database behind it, the training tool can be accessed simultaneously by a huge number of participants, while the results can still be provided individually in a very efficient way. As such, all actors are offered the possibility to gain a better understanding of the rules of the game and their proper application.

Summary and Conclusions

The expert perception and performance approach provides a valuable framework to study the mechanisms that mediate the acquisition, training, and improvement of decision-making skills. Compared to players, sports officials do not usually routinely practice their technical, tactical, and physical

skills in a coherent way. For referees, the match is a learning rather than a performance context because it provides the best moment for training role-specific skills, much more than during physical training sessions.

In addition to the mere study of the written rules and the observational learning they do during refereeing courses, complementary tools should be considered to compensate for the practice-poor context by integrating perception, decision-making, and communication into the training sessions and the overall instructions. Therefore, the following tools may be considered: (i) on-field exercises with players, (ii) on-field review exercises with video clips of match incidents, (iii) online perception and decision-making exercises such as P4P, and (iv) a combination of all.

While beneficial to sports officials in most individual and team sports, the ideas discussed in this chapter may have implications for those attempting to improve split-second decisions under emotional and time stress in other performance domains (e.g., airplane piloting, air traffic control, (micro) surgery, police decision-making, the military) as well as to motor learning and skill acquisition in many daily life activities and professional settings (e.g., traffic), and in certain pathologies. All of these target groups need additional learning opportunities to optimize the probability of successful performances in professional settings.

Key Messages

- Supplementary training is needed to compensate for the practice-poor culture of officiating.
- The effect of perceptual-cognitive training may be 10–15% if feedback is given immediately.
- Online training is complementary to other training programs.
- Some key advantages of online training are that there is no extra physical load, very valuable following an injury or to compensate for not being involved actively, saves money rather than takes money, and can be done whenever and wherever.

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