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Web-based training improves on-field offside decision-making performance

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ABSTRACT

Objective: The present study examined to what extent off-field offside decision-making training transfers to real-life offside situations.
Design/methods: Eighteen Belgian assistant referees were included in the experiment. Ten assistant referees (i.e., training group) were exposed to a pre- and posttest and, in between, four off-field offside training sessions via a web-based training protocol. The remaining eight assistant referees participated in the control group and only completed the pre- and posttest. During both test sessions, which were conducted separately for each group, both an on- and off-field offside decision-making test was completed.
Results: First, an increase in response accuracy and a decrease in flag errors were observed for the training group from pre- to posttest in both the on- and off-field offside test. Second, only the training group improved in the recall and recognition accuracy of the position of the receiving attacker at the moment of the pass.
Conclusions: This study demonstrates that perceptual-cognitive skill training results in a positive and direct transfer to on-field offside decisions. Therefore, the structure and the content of the current training intervention mimics the perceptual difficulties of real-match situations and can help the assistant referees to mediate and enhance their offside decision-making skills, both on- and off-field.

Although the offside law in association football (also known as soccer in North-America) is very precisely defined, it remains obvious that assessing offside situations under time-constrained circumstances is a very demanding and complex task, even for well-trained international assistant referees (i.e., Catteeuw, Gilis, Garçia-Aranda, et al., 2010). Law 11 (FIFA, 2012) states that "A player is in an offside position if he is nearer to his opponents' goal line than both the ball and the second-last opponent". The assistant referee has to assess the exact position of the receiving attacker relative to the second-last defender at the exact moment the ball is played.

In the literature, two well-known hypotheses have been introduced to explain incorrect offside decision making. Oudejans et al. (2000, 2005) suggested the *'optical error hypothesis'* to clarify incorrect offside judgments. First, these authors differentiated between two types of errors: a flag error occurs when an assistant referee indicates offside, or raises his flag, while the attacker was in an onside position. The opposite (i.e., non-flag error) takes place when an assistant referee indicates onside, or does not raise his flag, while the attacker is in an offside position. Second, they pointed out that the position of the assistant referee in relation to the second-last defender has a detrimental impact on the accuracy of their decisions. Therefore, both types of errors (i.e., flag error and non-flag error) seemed to depend on an inappropriate position of the assistant referee (i.e., leading or trailing the offside line) and the corresponding incorrect viewing angle. When the assistant referee is leading the offside line, more flag errors will be made when the attacker is on the opposite side of the second-last defender and more non-flag errors when the attacker is on the near side. On the other hand, when the assistant referee is trailing the offside line, more non-flag errors are expected when the attacker is on the opposite side of the second-last defender and more flag errors will be found when the attacker in on the near side. Mallo, Frutos, Juarez, and Navarro (2012), however, recently demonstrated that the distance of the assistant referee to the offside line did not have an impact on the quality of the offside decision. The viewing angle did not seem to affect correct offside decision making, as they did not report differences between correct (29°) and incorrect (25°) decisions.

The second hypothesis and a major contributor to errors in judging offside situations, refers to the *'flash-lag effect'*. This is a

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perceptual illusion in which a moving object is spatially perceived leading its real position at an instant defined by a time marker, usually a briefly flashed stimulus (Nijhawan, 1994). If this perceptual phenomenon is translated to offside situations in association football, this means that the receiving attacker (moving object) is perceived ahead of his actual position at the moment of the pass (flash) (Baldo, Ranvaud, & Morya, 2002). Until now, there is convincing evidence that the flash-lag effect is the driving contributor to explain the majority of incorrect offside decisions in both laboratory-controlled tasks that reduce the complex situation to its essence (Catteeuw, Helsen, Gilis, Van Roie, & Wagemans, 2009; Gilis, Helsen, Catteeuw, Van Roie, & Wagemans, 2009; Gilis, Helsen, Catteeuw, & Wagemans, 2008), as well as in real-match situations (Catteeuw, Gilis, Garçia-Aranda, et al., 2010; Catteeuw, Gilis, Wagemans, & Helsen, 2010a). This illusion clearly results in an overall bias towards flag errors in comparison with non-flag errors.

To better deal with the illusive effect of flash-lag on the one hand, and to further stimulate the acquisition and fine-tuning of offside decision-making skills on the other hand, video training can provide the assistant referees with additional experience outside the real-life matches. Catteeuw, Gilis, Garçia-Aranda, et al. (2010) revealed that during the 2002 and 2006 World Cups, only 5.3 and 7.4 offside situations per match were observed, respectively. Therefore, video training can be considered as a complimentary tool to provide the assistant referees more exposure and consequently, to improve their offside decision-making performance.

During the last decade, several studies demonstrated the benefits of off-field perceptual-cognitive skill training. It has already been shown that simulation-based training is effective in improving (sports) performance in, for example, American football (Christina, Baressi, & Schaffner, 1990), basketball (Gorman & Farrow, 2009), driving (Devos et al., 2009), hockey (Williams, Ward, & Chapman, 2003), medicine (Crochet et al., 2011), military combating (Ward et al., 2008), sailing (Walls, Bertrand, Gale, & Saunders, 1998), softball (Gabbett, Rubinoff, Thornburn, & Farrow, 2007), squash (Abernethy, Wood, & Parks, 1999) and tennis (Farrow & Abernethy, 2002; Smeeton, Williams, Hodges, & Ward, 2005; Williams, Ward, Knowles, & Smeeton, 2002). Furthermore, there is clear evidence that off-field perceptual-cognitive skill training, without the requirement of extensive in-game experience, can even stimulate the development of the decision-making skills of (assistant) referees in rugby (Mascarenhas, Collins, Mortimer, & Morris, 2005), Australian football (Larkin, Berry, Dawson, & Lay, 2011) and association football (Catteeuw, Gilis, Jaspers, Wagemans, & Helsen, 2010; Catteeuw, Gilis, Wagemans, & Helsen, 2010b; Schweizer, Plessner, Kahlert, & Brand, 2011).

In two different training programs, Catteeuw, Gilis, Jaspers, et al. (2010) and Catteeuw et al. (2010b) showed that off-field offside decision-making training, using computer animations and video simulations, is effective to improve the overall off-field decision-making performance of elite assistant referees. The results showed an improvement in response accuracy on the offside decision-making task and a significant decrease of flag errors from pre- to posttest. Both formats (i.e., computer animations and video simulations) induced a similar positive learning effect and mediated a compensation strategy for the flash-lag effect that results in a suppression of its effects. They learned to cognitively correct their visual perception to make an accurate decision. Only four training interventions, with extended feedback, already seemed effective to eliminate the forward memory shift induced by the flash-lag effect and eventually, to enhance the off-field offside decision-making performance. Unfortunately, all of these authors did not examine the transfer of this type of perceptual-cognitive training to the real world of on-field (offside) decision-making and therefore, the previous findings should be interpreted with some caution.

Hence, the major aim of the present study is to examine to what extent off-field offside decision-making training transfers to real-life offside situations. The design of the present training intervention in terms of feedback, training formats (i.e., computer animations and video simulations) and number of training sessions is based on the study of Catteeuw, Gilis, Jaspers, et al. (2010). These authors showed that successful performance from pre- to posttest was obtained in the presence of accurate, relevant and immediate feedback (i.e., correct answer, slow motion of the offside simulation and freezing at the moment of the pass) during the training sessions. Assistant referees could immediately compare their own perception with the real positions of the players, implicating the possibility to adjust their (incorrect) perception at all times. Unfortunately, this study only examined the training effect on off-field decision making. Therefore, a unique and innovative feature of the current research is that the effects of off-field offside training are examined in on-field decision-making situations.

In this transfer study, we expect an increase in response accuracy and a decrease in flag errors for on-field performance from pre- to posttest for the training group, whereas no change is expected for the control group. After assessing each offside situation, the assistant referees had to recall the exact position of the receiving attacker relative to the offside line (i.e., second-last defender) at the moment of the pass. This recall task gives a clear indication of the quality of the 'mental picture' of a given offside situation. We predict a considerable improvement in the recall of how the assistant referees of the training group will perceive and assess the positions of the different players. Thus, we anticipate that the perceptual-cognitive skills (i.e., decision making, recall and recognition) acquired throughout the online training interventions with extensive feedback, directly transfer to a better and more accurate performance during the assessment of on-field offside situations in the posttest.

In general, we expect that the training intervention will help the assistant referees to better deal with the consequences of the flash-lag effect, both on- and off-field, and that the progress observed during the training period will transfer to the posttest. In addition, in line with the results of Catteeuw, Gilis, Jaspers, et al. (2010), we expect for the training group an increase in response accuracy, a decrease in flag errors and an improvement in the frame recognition task for off-field offside decision making from pre- to posttest.

Method

Participants

Eighteen Belgian assistant referees (mean age = 29.2 years; $SD = 5.8$) were included in the experiment. They were all active in the second, third and fourth division in Belgium, with an average experience of 5.3 years ($SD = 3.3$). Ten assistant referees constituted the training group (mean age = 27.2 years; $SD = 3.4$; average experience: 4.8 years; $SD = 3.2$) and they were exposed to a pre- and posttest and in between, four off-field offside training sessions via a web-based training protocol. The remaining eight assistant referees participated in the control group (mean age = 31.1 years; $SD = 7.7$; average experience: 5.9 years; $SD = 3.5$), which only completed the pre- and posttest. During both test sessions, which were conducted separately for each group, both an on- and off-field offside decision-making test was completed. In the on-field test, the assistant referees judged real-life offside situations representing typical offside situations. In the off-field test, 40 offside situations in a video-simulation format and 40 offside situations in a computer-animation format were considered. The experimental