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Using perceptual home-training to improve anticipation skills of soccer goalkeepers

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ABSTRACT

Objective: This study aims to test the effectiveness of a perceptual training concerning the anticipatory skills of soccer goalkeepers, by assessing their performances while engaged in predicting the direction of penalty kicks.
Design: Forty-two skilled goalkeepers were randomly assigned to three training groups: Experimental, placebo, and control. All the groups were tested at the beginning of the experiment and re-tested after a period of eight weeks.
Method: The pre-test consisted of the presentation of temporally occluded videos of penalties recorded from the goalkeeper's perspective, and participants had to predict the direction of the ball. The experimental group practiced with an interactive home-training, based on video analogous to those of the test, with the addition of both positive and negative feedback. The placebo group viewed television footage of penalty kick shoot-outs. Participants of both groups were free to schedule their own training/placebo sessions. Finally, the control group did not receive any treatment.
Results: The results demonstrated the effectiveness of the home-training protocol, evidencing significant accuracy improvements between pre-test and post-test only for the experimental group.
Conclusions: The outcomes indicate that skilled athletes can benefit from perceptual training, which was not investigated before among soccer goalkeepers. Indeed, all the previous training studies concerning soccer penalty predictions were run on participants with either recreational or no goalkeeping experience at all. Moreover, the present training protocol is innovative because learners can schedule training sessions on their own. Finally, its usability suggests numerous potential applications.

Perceptual skills are fundamental in many everyday activities such as driving a car, dancing, and playing sports (Jackson & Farrow, 2005). In fact, in all these activities it is required to perceive environmental changes or the movement of others in order to interact with the environment or with other people (Murgia, Hohmann, Galmonte, Raab, & Agostini, 2012). Generally, human perceptual skills improve with experience, which means that we refine our perceptual strategies by practicing with a given situation. In other words, learning processes imply improvements in complex perceptual-based skills as a consequence of a training (Sowden, Davies, & Roling, 2000; Ste-Marie et al., 2012). The concept of training assumes a particular importance for elite-level athletes, given their need to optimize the performances by taking care of every detail. Usually coaches focus on physical and tactical aspects of training, while other central issues concerning perceptual and motor skills are often recognized as important, but are rarely systematically trained. For this reason, in this paper we propose an innovative protocol to train soccer goalkeeper perceptual skills.

Motor and perceptual skills represent an important requirement for goalkeepers, since they have to quickly capture the environmental information (e.g. game dynamics, opponent's movements during the execution of a penalty kick) and react as rapidly as possible in order to maximize their chance to catch the ball and save the goal. To achieve this aim, the first step is to understand what is happening in a particular moment, that is goalkeepers must be trained in "reading" the perceptual scene in order to anticipate their own movement.

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The benefits of anticipating opponents' actions have been studied in many sports, and anticipation abilities result to be strongly associated with expertise (Mann, Williams, Ward, & Janelle, 2007). Researchers indicated that one of the fundamental skills that differentiates expert players from novice ones is the ability to read and interpret the kinematic information present in the opponent's movements, having more time to execute an appropriate response (Abernethy, Gill, Parks, & Packer, 2001; Abernethy & Russell, 1987; Shim, Carlton, Chow, & Chae, 2005). This assertion is supported by empirical evidence in many sports, including badminton (Wright, Bishop, Jackson, & Abernethy, 2011), cricket (Mann, Abernethy, & Farrow, 2010; Müller et al., 2009; Weissensteiner, Abernethy, Farrow, & Müller, 2008), fencing (Hagemann, Schorer, Canal-Bruland, Lots, & Strauss, 2010), karate (Mori, Ohtani, & Imanaka, 2002), squash (Abernethy, 1990), tennis (Jones & Miles, 1978; Rowe & McKenna, 2001; Tenenbaum, Sar-El, & Bar-Eli, 2000), and soccer (van der Kamp, 2011; Núñez, Oña, Raya, & Bilbao, 2009; Williams, 2000; Williams & Davids, 1998).

The above mentioned studies point out the gap between expert and novice athletes, suggesting that it is possible to create specific trainings to improve athlete anticipation skills. Moreover, previous work based on video analysis provides evidence suggesting that anticipation skills are particularly important for soccer goalkeepers. For instance, Franks and Hanvey (1997) analyzed the penalty kick videos of FIFA world cup finals between 1982 and 1994 and found that the average time between the ball contact and the goal line crossing was 600 ms, while the time for the goalkeepers' bodies to cross the possible path of the ball ranged between 500 and 700 ms, depending on the goalkeepers' action capabilities (as highlighted also by Dicks, Davids, & Button, 2010; Righi, Modolo, Galmonte, & Agostini, 2004). It means that goalkeepers need to start their movement approximately when the opponent is kicking the ball and, consequently, it implies that they need to plan their movement before the kicker-ball contact (Schmidt & Lee, 2005). Therefore, goalkeepers are forced to use the information provided by kickers during their run-up in order to have more chance to save the penalty.

An important issue addressed by some authors is the analysis of what regions of the opponent's body provide goalkeepers with useful information. Traditionally, these studies adopted paradigms based on tracking athletes' visual fixations, or on the presentation of spatially occluded videos, usually created by hiding some portions of the visual scene (Mecheri, Gillet, Thouvarecq, & Leroy, 2011). Altogether, the results of these studies point out that the non-kicking foot and leg provide the most informative cues to predict the direction of penalty kicks, while other cues, such as head, trunk and arms, seem to be less useful (Piras & Vickers, 2011; Savelsbergh, Williams, van der Kamp, & Ward, 2002; Savelsbergh, van der Kamp, Williams, & Ward, 2005). However, while the above mentioned studies focused on identifying information that is localized to specific parts of the body, a more recent study considered also the reliability of distributed sources of information and found that goalkeepers are sensitive to information distributed across the body of the kickers, too (Diaz, Fajen, & Phillips, 2012).

The individuation of the most informative regions of athletes' bodies has allowed researchers to design perceptual training protocols, in which explicit rules were provided to learners (Williams & Hodges, 2005). The general idea underpinning explicit trainings is that the experimenters can facilitate the learning process by guiding the attention of the learners (e.g. Abernethy, Wood, & Parks, 1999). However, some evidence suggested that explicit information is not necessary, since implicit trainings can be equally effective (Masters, Poolton, Maxwell, & Raab, 2008; Raab, 2002). For instance, Farrow and Abernethy (2002) compared the effectiveness of explicit and implicit training protocols aimed at improving the ability to predict the direction of tennis serves, through the observation of temporally occluded video footage. The explicit training was specifically focused on providing athletes with instructions on service kinematics that are important for determining the serve direction. Conversely, the implicit training forced participants to focus on a secondary performance-related aspect, as athletes were required to predict the serve speed. The implicit training promoted greater improvements in both verbal anticipatory predictions and real-world motor responses compared to the explicit training, thus demonstrating that implicit trainings can be even more effective than explicit ones.

Farrow and Abernethy (2002) also highlighted the effectiveness of perceptual trainings when perception and action are separated and, consequently, they emphasized the possibility to transfer the improvements acquired with perceptual trainings to real-world situations, although there is a controversy about this issue. Indeed, some studies point out that the pick-up of information differs between perception-only and perceptual-motor tasks (Dicks, Button, & Davids, 2010). However, more recent studies demonstrate that transfer of improvements to real-world situations is possible after both perceptual-motor trainings (Hopwood, Mann, Farrow, & Nielson, 2011) and perceptual-only trainings (Put, Wagemans, Jaspers, & Helsen, 2013).

This last evidence suggests the plausibility of a common representational mechanism between perception and action, as postulated by the common coding theories (Hommel, Müsseler, Aschersleben, & Prinz, 2001; Prinz, 1997). According to these theories, a common representational system for codes of perceived events and planned actions would allow perceptual codes and action codes to prime each other. As a consequence, in our case, perceptual experience of visual training would activate representational codes that would be directly retrieved by the action systems. Moreover, the activation of codes due to motor experience would affect the perceptual outcome, providing an explanation for the expertise differences in perceptual occlusions tasks. This framework seems consolidated in the domain of simple movements, nevertheless only a few studies considered this theoretical background for complex movements (see, for instance, Abernethy & Zawi, 2007; Murgia et al., 2012). However, even though a theoretical framing is necessary, our focus will not be directed on theoretical aspects, but on applied issues of perceptual trainings for soccer goalkeepers.

As concerns soccer, it has been demonstrated that the application of perceptual trainings to penalty kicks induces improvements in predictive abilities of novice participants. The first attempt to improve the predictive abilities of penalties from the goalkeeper perspective was done by Poulter, Jackson, Wann, and Berry (2005). They compared the effectiveness of explicit and implicit perceptual trainings on a sample of female university students with no previous experience of viewing penalty kicks or playing soccer. The pre-test examined the ability of participants to orally predict the direction of penalty kicks – choosing among one of the four corners of the goal – using clips occluded one frame prior to foot-ball contact. After the pre-test, participants were randomly assigned to one of the four groups: explicit learning, implicit learning, placebo, and control. The post-test results pointed out significant improvements in the horizontal dimension (right – left) for the explicit and placebo groups, but no significant improvement in the vertical dimension (high–low).

Work by Savelsbergh, van Gastel, and van Kampen (2010) addressed the same issue. They examined a sample of university students with recreational goalkeeping experience and tried to improve their predictive abilities with a temporal occlusion paradigm, in which the first portion of ball flight was available. They tested two trainings, one strictly implicit and one implicit with