Gaze Behavior of Elite Soccer Goalkeeper in Successful Penalty Kick Defense

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The purpose of this study was to investigate the differences in the ability of soccer goalkeepers to anticipate the direction of penalty kicks. Six elite goalkeepers with more than 10 years of experience participated in this experiment. Participants were required to press a reaction button as soon as they could estimate the direction of the ball while watching videos of penalty kicks. For this experiment, an eye movement tracking system (EMR-8), a reaction system, videos, a beam projector, and a screen were prepared. To analyze the goalkeepers’ gaze fixation, the kicker’s kicking motion was divided into two sequential phases: the approach and the kick swing. The major conclusion from this experiment was that the gaze fixations of elite goalkeepers in successful defense are different than ones in cases of failure. Successful defense of penalty kicks involved fewer gaze fixations of longer duration than unsuccessful defense. Also, there was a significant difference in the way that elite goalkeepers gazed at the kicker’s shoulder zone during the approach phase and at the upper trunk, the zone between the ball and non-kicking leg, during the kick-swing phase. In conclusion, successful defense seems to be based on a target control strategy, which consists of eye fixation on a single location, from which it is possible to grasp events around the visual fixation point. Thus, the accuracy of anticipation depends on the ability to shift visual attention from one location to another by identifying the useful cue in the visual field and using peripheral vision.

key words: Anticipation, Gaze fixation, Target control strategy, Context control strategy

Introduction

What are the main factors that lead to successful motor performance by athletes when a competition changes in various and rapid ways? Despite their skills, athletes cannot always perform at the highest level because the results of their performance

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are different each time. Therefore, among elite goalkeepers, what is the reason for success or failure of elite goalkeepers in penalty kick defense? The purpose of this study was to provide information usable in competition by finding answers to these questions.

Many sport scientists have turned their attention to physiological expertise, technical expertise, and psychological expertise in order to find the determinating factors of successful motor performance. But recently, in the field of motor control, skills in perception and anticipation appeared before pertinent motor behavior. In establishing the facts which determine those behaviors, the sport scientists are focusing on the studies concerning cognitive expertise (Starkes & Ericsson, 2004). Especially, the ability to anticipate a situation rapidly and exactly is needed to perform skillfully when a goalkeeper’s own motion is decided by an opponent’s motion. Therefore it is possible to say that the success and failure of motor performance is up to the information literacy emerging from the use and incipient recognition of the “advanced visual cue” in environmental context for anticipating the coming events consistently (Williams & Hodges, 2004).

Generally, most leading studies concerning the skillful management of perception provide much information through comparison of experts and beginners (Seonjin Kim, 2000; Seonjin Kim et al., 2005; Seungha Park & Seonjin Kim, 2004; Abernethy, 1987; Abernethy & Russell, 1987; Bard & Fluery, 1976; McMorris & Colenso, 1996; Savelbergh et al., 2002). With these studies, it has been found that an expert is superior to a beginner in using broad knowledge concerning the situational possibilities by perceiving, recalling and analyzing organized sports situations. In connection with the above, Cave & Bichot (1999) proposed that, concerning the difference in obtaining information through perception, beginners mainly utilize the information obtained from the visual circumstances for the response, based on a “target control strategy”. Experts, in contrast, do it based on a “context control strategy”. A target control strategy is to obtain information through focal vision system by fixing one’s gaze on an optic clue, and context control strategy is to obtain information through peripheral vision system while also fixing the gaze on an optic clue (Tenenbaum & Bar-Eli, 1995). In this way, it has been found that the difference of the strategies in obtaining information influences on the data processing ability for making decisions and withdrawal and storage of structured information (Tenenbaum & Bar-Eli, 1993).

These leading studies make clear the difference of skill expertise in the