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Research article

THE INFLUENCE OF INSTRUCTIONS ON REACTION TIME AND DEFENSIVE EFFICIENCY IN FOOTBALL

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Abstract. *Any delay in making a decision in games greatly reduces the efficiency of football players during competitive activities. The aim of this research was to examine the impact of instructions on defensive efficiency. Defensive efficiency was assessed based on the achieved reaction time of the participants in quasi-specific football situations in one-on-one games, using video-based methods. The sample consisted of 20 males, divided into two equal groups: top football players and students. The results of the study have shown that top footballers have a more efficient defensive strategy compared to students, with significant differences observed when presented with stimuli without a fake move ($F = 7,190$, $p = 0.015$). The differences were not significant after the response to the stimuli with a fake move ($F = 0.348$, $p = 0.563$), but it should be noted that in three out of four cases, the players had a slightly shorter average reaction time. Still, the results have shown that experimental instructions had no effect on defensive efficiency when presenting simple stimuli ($F = 2.281$, $p = 0.148$), as well as when presenting more complex stimuli with a fake move ($F = 1.170$, $p = 0.294$). Instructions have an important place in young players' training, but defensive efficiency of top players is affected by how well-trained they are, which is manifested through the adopted mechanisms as a result of training. Therefore, it can be concluded that giving instructions must be a part of the individual approach depending on the skill level of the person whom it is communicated to.*

Key words: *motor control, reaction speed, video-based method, dribbling*

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1. INTRODUCTION

Conditions for performing in modern elite sports require athletes to be fast in making adequate decisions when resolving complex competitive situations. Shorter reaction time can significantly affect performance efficiency in most sports (Ric et al., 2017). Bearing in mind that football players encounter complex situations during the games when it is important to pay attention to several factors (Ruschel et al., 2011), the ability to react quickly has a huge impact on the player's performance during competitive activities.

The introduction of new rules, improvement of playing conditions and use of modified modern training technology have led to an increase in modern football dynamics. Observed differences between the technical and tactical performance of the players who play in different ranks clearly indicate that better players are prepared through training for playing fast with a high degree of ball control (Leontijević, Janković & Tomić, 2018). Due to tactical ideas of football experts, the density of players in the area around the ball has increased, causing a higher frequency of passes by 35% and a higher ball speed by 15% (Wallace & Norton, 2014). In addition, the number of contacts with the ball decreases and ranges from 1.87 to 2.23 contacts by individual possession depending on the position of the player (Dellal, Wong, Moalla & Chamari, 2010). It is clear that current trends are forcing footballers to use rational and simple solutions in the game, that is, to quickly make decisions with and without the ball in complex game conditions (Janković & Leontijević, 2016). Any delay in making a decision during games can significantly impair football players' efficiency (Schmidt & Wrisberg, 2000), so the assessment of sensory and motor abilities of players is of great importance for the scientific and professional population.

Footballers must have a high level of visual and perceptual skills in order to be trained to collect and process information in the shortest possible time, and then select effective motor responses based on the analysis of a large number of factors (Williams, 2000). The analysis of the results of previous research showed that football players have shorter response time than recreational players (Ando, Kida & Oda, 2001), but it was noticed that there is inconsistency in the results when comparing reaction times of different quality footballers. By using a complex and expensive system, such as virtual technology, which is not available to many researchers, Wood et al. (2020) showed that there are differences between professional football players, players from the academy, and beginners, while in other studies there were no differences between players at different levels (Ruschel et al., 2011; Ricotti, Rigosa, Niosi & Menciassi, 2013). Yet, the results presented in studies where no differences were found are limited in value when generalizing conclusions because of the method used (computer – finger) to estimate the reaction time (Peiyong & Inomata, 2012). In addition, the basic video-based method for assessing sensory and motor abilities of athletes stood out as a reliable, sensitive and accessible method for estimating reaction time. Using this method, which makes it possible to ensure a high level of ecological validity of the test, the research results showed that top athletes, in samples of karate, fencing and football athletes, achieve shorter reaction time compared to students (Mudrić, Ćuk, Janićijević, Nedeljković & Jarić, 2015; Milić, Nedeljković, Ćuk, Mudrić & Garcia-Ramos, 2019; Tomić, Janićijević, Nedeljković & Leontijević, 2021).

Theorists agree that success in performing motor activities largely depends on attention, and attention is influenced by various pieces of information that reach the human system from different sources in the environment (Cattel, 1893; Bernstein, 1996; Schmidt & Lee,

2005). In sports, verbal instructions are one of the most important sources of information and is an indispensable method of training when giving targeted information relevant to motor activities performance. It has a special contribution during the training of players (Aleksić & Janković, 2006). In addition to the mentioned research in which football players' sensory and motor abilities were examined, scientists were interested in detecting more efficient visual strategies for solving various offensive and defensive activities of players by estimating reaction times (Vaeyens, Lenoir, Williams & Philippaerts, 2007; Krzepota, Stepinski & Zwierko, 2016). The players who successfully solve one-on-one situations in offensive and defensive terms are of special importance in football. The results of previous research confirmed that top players have a more efficient strategy due to the defensive activities reflected in a shorter time interval from the appearance of the stimulus to the beginning of the adequate response (Krzepota et al., 2016). Professional literature suggests that defensive players in one-on-one situations should focus on the ball (Luongo, 2000; Harrison, 2003), to avoid responding to attackers' fake moves. However, the analysis of other results (Williams & Davids, 1998; Nagano, Kato & Fukuda, 2004) concludes that a certain group of authors emphasises hips and knees as important regions for predicting the movement activities of players with a ball. These observations leave room for further discussion when it comes to detecting more efficient strategies in football players' individual defense.

Based on previous research, we can expect that the participants in our study will achieve a shorter reaction time after the verbal instructions directing the visual focus towards the ball compared to the instructions directing the visual focus towards the knee. The aim of this study was to examine the impact of instructions on defensive efficiency in quasi-specific football situations, by using the basic video-based method and assessing reaction times. The results obtained could affect improving the methodology for training young players in terms of clearer instructions on taking a defensive position towards the attacker with the ball.

2. METHODS

2.1. Sample

The sample consisted of 20 males, divided into two equal groups. One group consisted of top football players (N = 10, age: 20.9 ± 3.6 years; weight: 75.4 ± 6.5 kg; height: 1.82 ± 0.05m), represented by players of the senior squad of FK Partizan Belgrade. The other group included students (N = 10, age: 23.4 ± 0.5 years; weight: 86.0 ± 10.2 kg; height: 1.84 ± 0.03m) from the Faculty of Sport and Physical Education. For both groups of participants, there were clear inclusion criteria. The football players had to meet the requirement that they had been actively training football for at least 10 years and that they were playing in a professional football club at the time of testing. The basic criterion for the students was that they gained the experience of playing football exclusively during their Football course, and that they had not had previous training experience with similar ball sports. Just one participant from the total sample indicated the left leg as dominant. The entire testing protocol was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Belgrade (02 - 462 / 20-1), and was designed in accordance with the Declaration of Helsinki.

2.2. Instruments

The following instruments were used during the experiment:

- A video camera (Basler BIP2, Ahrensburg, Germany) for recording a model's offensives activities used as a stimulus during the testing;
- Two force platforms (AMTI BP600400, Advanced Mechanical Technology, Inc. Watertown, MA 02472-4800 USA) to identify relevant points that marked the beginning of the models' and participants' movement (Mudrić et al., 2015; Milić et al., 2019; Tomić et al., 2021);
- A projector and a screen for showing the stimuli to the participants;
- A football;
- A trigger for a synchronized start of the camera and force platforms during the model's recording, as well as the projector and force platforms during the participants' testing;

2.3. Design

The experimental protocol was conducted in the laboratory of the Faculty of Sport and Physical Education in Belgrade and consisted of two separate activities. The conditions in the laboratory were optimal and the room was slightly darkened for a clearer presentation of the video stimuli. The first step involved recording the offensive activities of the model, which was later used for stimuli during testing. After selecting and preparing a video presentation, the participants were tested on a separate occasion.

2.3.1. Offensive actions - "stimulus" recording

By analysing the application of dribbling in football (Janković & Leontijević, 2008) it was decided that offensive actions consist of basic external dribbling and skipping sideways (Fig. 1). The role of the model was played by a top football player who was not in the sample of participants. By taking a parallel position on the two synchronised force platforms, the model was placed at a distance of 2m from the camera used to record the stimuli (Figure 2A). After positioning the model, the first instruction "READY" ensued, after which the model remained still for the next 6 seconds. This was followed by the instruction "GO" after which the model performed the previously agreed offensive action.

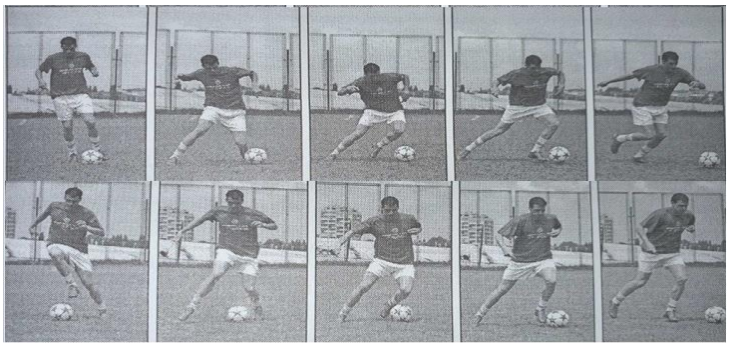

Fig. 1 Offensive actions of the model - basic external drilling (row I), skipping sideways (row II). (adapted from Aleksić & Janković, 2006)

2.3.2. Defensive actions - "response" recording

During the tests, the participants took an optimal defensive position by placing the feet parallel on the force platforms (Figure 2B). The participants' response meant tackling by stepping forward (Janković & Leontijević, 2016). When applying the stimulus with a fake move (skipping sideways), the participants ended the response by stepping to the side to which the model carried away the ball, no matter whether the wrong response was initially initiated under the influence of the feint of the model.

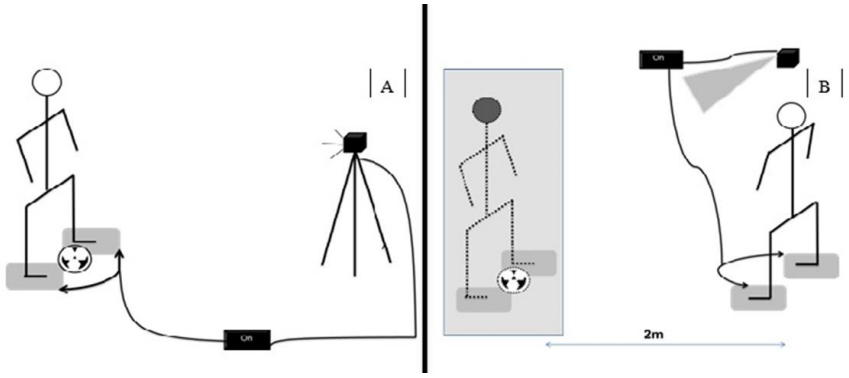

Fig. 2 Experimental design, A - stimulus recording, B - participant testing.

2.4. Testing Procedure

The experimental condition of the research was the verbal instruction given by the researcher to the participant immediately before each experimental attempt. The instruction was “ball” or “knee”, and based on it, the participant was supposed to direct his visual focus on the designated model space when responding. Complex reaction time was assessed in the research, bearing in mind that the participant could expect one of four different offensive actions after each instruction.

The expected testing duration depended on the individual arrival of each participant according to a pre-arranged schedule. Bearing in mind that the testing was conducted during the season of the National Football Championship in Serbia, and due to frequent professional obligations of the participants from the professional players group, the testing procedure differed between the groups of participants in terms of the number of experimental attempts. Participants from the group of students had 24 experimental attempts each (3 attempts x 4 stimuli x 2 instructions), and from the top football players’ group, 16 experimental attempts (2 attempts x 4 stimuli x 2 instructions).

Prior to the test itself, the participants could perform a basic warm up on their own - dynamic stretching, and then a specific warm up – trial attempts (2 attempts on each stimulus and experimental condition). Testing ensued upon completion of the warm up. After the experimental instructions (ball or knee), followed by the first instruction "READY" - the participant placed himself on the force platforms and took the optimal defensive position (Figure 3). This was followed by the second instruction "GO" - which meant that at that moment the trigger was used to start the presentation of the offensive stimulus on the screen.

At the end of the experimental attempt, the participant left the platforms only after the video ended. In order to prevent the participants from being able to predict the stimulus that awaited them in the next experimental attempt, they were presented with experimental attempts in random order. In addition, the duration of offensive actions recording, from the announcement of the second instruction by the researcher to the beginning of the dribbling, varied from 1 to 5 seconds. Also, compared to the total number of experimental attempts, there were 20% "fake specimens" of stimuli during which the model did not perform any movement. In case of a wrong response, the attempt was repeated later during the testing. The entire testing was conducted in line with the previously prepared protocols in the presence of the same researcher.

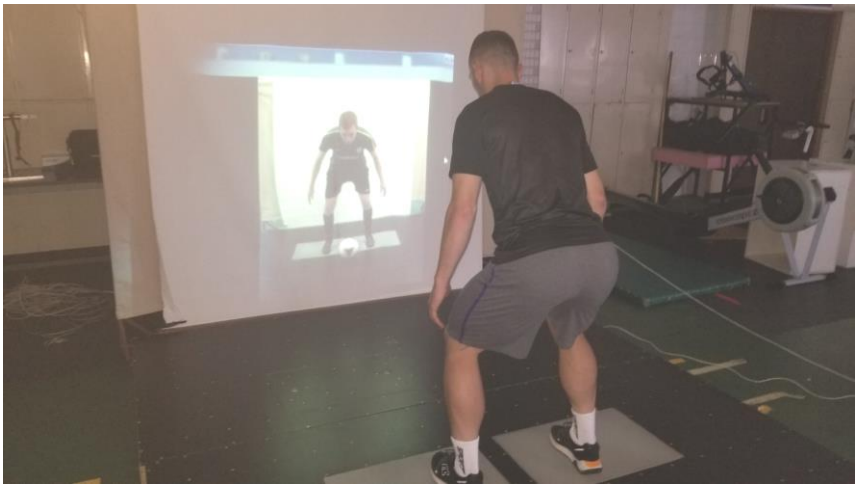

Fig. 3 Experimental setup.

2.5. Data Analysis

Specialized software (National Instruments LabView Student Edition 2007, Austin, TX, USA) was designed for this research. The software processed all the signals recorded by the force platforms when performing offensive activities by the model and later responses by the participants during the testing. The developed software enabled the discovery of relevant points for determining the beginning of the activity of the model and the participants in the experiment (Figure 4). Depending on the type of stimulus, it was necessary to determine the following points for both the models and the participants:

- The beginning of the movement - this point is sought in all offensive stimuli and it represented the first change of force greater than 5% compared to the maximum values of rate of force development (RFD), with either foot.
- The beginning of the real movement - this point had to be found when presenting offensive stimuli with the feint, or skipping the ball. For the model, it represented the peak of force achieved by the foot which the model stepped on after the feint and began removing the ball to the real side. In the case of the participants, the beginning of the real movement was the peak of force exerted by the foot which they stepped on at the moment of initiating the response on the correct side when removing the ball.

Fig. 4 Processed force platform signal in LabView software.

After finding the necessary points, to assess the efficiency of the defense the following intervals were observed:

- When presenting offensive actions without fake moves, the difference noticed between the participants and the model for the point "beginning of the movement" is defined as the "***initial reaction time***" interval.
- When presenting offensive actions with a fake move, the difference between the "beginning of the movement" of the model and the "beginning of the real movement" of the participant was defined as the "***total reaction time***" interval.

2.6. Statistical Analyses

The lowest achieved participants' values were used for statistical data processing. A mixed analysis of variance ("between groups – within groups" ANOVA) was used to detect the differences for each of the four offensive stimuli and two instructions as a factor within groups. As a factor between the groups, the results were compared between the students and the top football players. When significant differences were determined, the Bonferroni post-hoc test was applied for the main factors. Statistical analysis was performed using Microsoft Office Excel 2010 (Microsoft Corporation, Redmond, WA, USA) and SPSS 22.0 (Inc., Chicago, IL), while the level of statistical significance was set at $p < 0.05$.

3. RESULTS

In situations when the participants were presented with a stimulus without a fake move (Figure 5) the results showed significant differences between the group of participants ($F = 7.190$, $p = 0.015$) and versions of offensive actions ($F = 12.247$, $p = 0.003$), but not when it comes to instructions ($F = 2.281$, $p = 0.148$). The interaction between the factors 'offensive action*instruction' turned out to be significant ($F = 5.736$, $p = 0.028$) and it was found that the differences in the initial reaction times were smaller during offensive actions when the participants' focus was on the knees. For other factors, there were no significant interactions, 'offensive action*group' ($F = 0.357$, $p = 0.557$), 'group* instruction' ($F = 0.013$, $p = 0.909$), as well 'offensive action*instruction*group' ($F = 3.309$, $p = 0.086$).

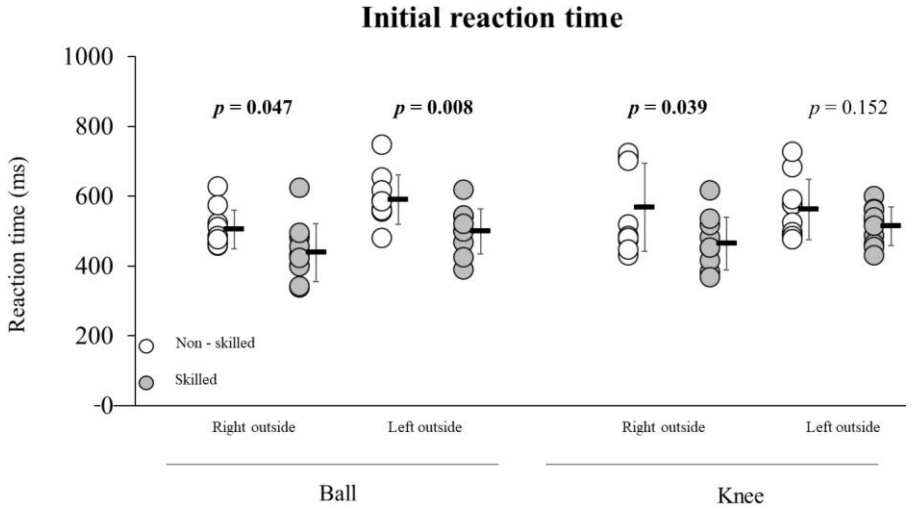

Fig. 5 Response time between students (clear circles) and football players (dark circles) in relation to different instructions (ball or knee) for offensive actions without a feint.

The results for the total reaction time (Figure 6) showed significant differences for the factor stimulus (F = 10.848, p = 0.004). The participants would start the correct response earlier when presented with a stimulus in which the model started the feint by skipping the ball to the right, and carried the ball to the left. However, the three-factor ANOVA did not show significant differences between instructions (F = 1.170, p = 0.294) and groups (F = 0.348, p = 0.563). In addition, the interaction between the main factors did not show statistical significance, 'offensive action*group' (F = 0.505, p = 0.486), 'group* instruction' (F = 2.019, p = 0.172), 'instruction*offensive action'(F = 0.201, p = 0.659) and 'offensive action*focus*group'(F = 0.080, p = 0.781).

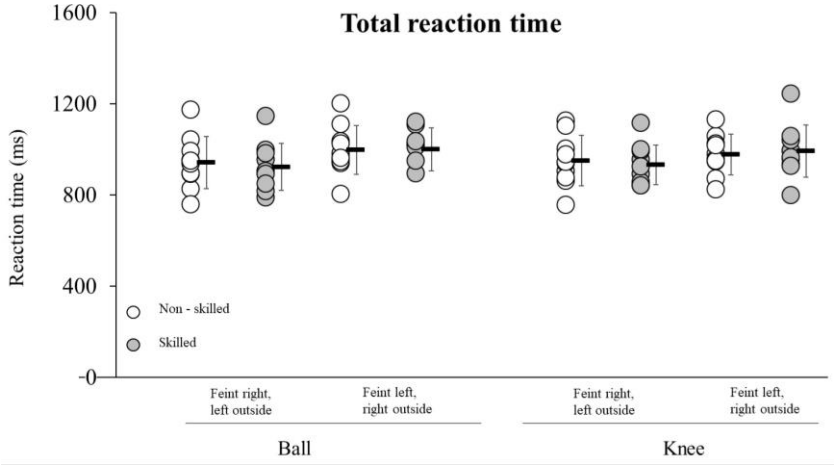

Fig. 6 Reaction time between students (clear circles) and football players (dark circles) in relation to different instructions (ball or knee) for offensive actions with a feint.

4. DISCUSSION

The aim of this research was to examine the impact of instructions on defensive efficiency. The efficiency of the defense was assessed based on the participants' reaction time in quasi-specific football situations, using a reliable and sensitive test – a video-based method (Tomić et al., 2021). Any delay in decision-making in a game greatly reduces football players' efficiency during competitive activities. The results indicate that the experimental instructions (ball or knee) had no effect on the defensive efficiency as no differences were observed in the participants' reactions. Also, the analysis of the results shows that top footballers have a more efficient defensive strategy compared to students. They achieved a significantly shorter initial reaction time (the response to the stimuli without feints). For the total reaction time (the response to stimuli with feints) no differences were observed between the groups, although in three out of the four cases the players had a slightly shorter average reaction time.

The fact that the participants are well-trained presents a significant factor in the reaction speed in a variety of situations (Schmidt & Lee, 2005). Perceptual abilities represent a significant criterion for participation in football, and the results of previous research show that the perceptual abilities of the players clearly make a difference in quality between footballers (Williams, 2000). Also, the results indicate that there is a positive correlation between the developed visual skill and players' tactical efficiency (Assis, Costa, Casanova, Cardoso & Teoldo, 2020). Somewhat different visual strategies have an impact on faster responses of better football players. It has been concluded that top player's visual focus is directed towards fewer specific regions of the opponent with a longer time interval dedicated to each region compared to beginners (Krzepota et al., 2016). Based on their experience, top athletes have mechanisms that allow them to perceive crucial information and thus predict subsequent opponent's activities (Shim, Carlton, Chow & Chae, 2005). This shortens the decision-making phase when processing information from the external environment and results in a shorter reaction time. Bearing in mind that the top football players in our study had a shorter reaction time compared to students, it is clear that the results of our research confirm the previous research. However, in our study, the football players did not achieve shorter reaction time when presented with more complex stimuli with feints. A study by Ando et al. (2001) concluded that footballers had shorter premotor reaction time compared to recreational players. In addition, it is known that frequent strength training, which is implied in the preparation of top footballers, has a positive effect on the rate of force increase (Pelton, Walker, Lahitie, Hakkinen & Avela, 2018). Bearing in mind the method for determining reaction times in our study, it can be said that, when presented with more complex stimuli, football players had more time to perceive important information about the stimuli before they started, and quickly performed a defensive action, as was also the case in the Craig (2014) study.

Resolving situations in an efficient way when playing one-on-one in football is a core component in the attack and defense phase (Harrison, 2003). Professional literature recommends focusing attention on the ball in defensive actions (Luongo, 2000; Harrison, 2003), with particular emphasis on the importance of instructions during players' training. The interpretation of the influence of instructions on focusing attention on crucial information processing when performing motor activities has long been present in science theory (Bernstein, 1996). However, a small number of studies have investigated the influence of verbal instructions on football players' performance (Beilock & Carr, 2002; Ford, Hodges & Williams, 2005). The results of our study have not shown that verbal instructions for

directing external focus has an impact on the participants' defensive efficiency. The results of the research conducted on a sample of golfers and football players showed that verbal instructions which affects the inner focus has a greater impact on beginners, while for more successful athletes, the instructions for directing external focus is more significant (Ford et al., 2005; Perkins-Ceccato, Passmore & Lee, 2003). Bearing in mind that in our research the instructions in both cases was meant to direct the external focus, it is clear why the instructions did not affect the defensive efficiency of the student group of participants. When examining the visual strategies of footballers, Nagano et al. (2004) emphasised that top players have a more open pattern that is manifested by directing attention to a wider space towards the opponent, encompassing the knees and hips besides the ball. Therefore, the results of our study for the group of footballers can be interpreted as a consequence of their already adopted strategy. Top players in defensive situations focus on 2-3 regions of the opponent, in order to collect as much necessary information as possible for starting the defense activity (Krzepota et al., 2016), and not on individual ones as was the case in our study.

5. CONCLUSION

It can be concluded that the conducted study confirms that top footballers have a more efficient strategy compared to students when making decisions in individual defensive actions. Therefore, the test used in this study can be implemented in the assessment of the sensory-motor abilities of players in separate quasi-specific football situations. It can also be used to identify talented players in younger categories (Savelsbergh, Haans, Kooijman & Kampen, 2010). However, the results of our study have not shown that verbal instructions for directing external focus had an impact on the participants' defensive efficiency. It can be concluded that defensive efficiency is influenced by several factors, but also, that, when giving verbal instructions, an individual approach is very important in terms of the skill level of the person being instructed.

Several limitations were noticed in the conducted study. Taking into account the sensitivity of the variable being assessed (reaction time), it can be said that a relatively small number of participants (because of the criteria for selecting top football players and students) was tested. Also, as a consequence of a large number of top players' professional obligations in the competition season, a slightly smaller number of attempts performed by the top players could have negatively affected the obtained research results. Further research should examine the impact of instructions on football players based on their positions in the team, i.e. compare defensive players to attackers, bearing in mind that in our research it was not a criterion for selecting top players.

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UTICAJ INSTRUKCIJE NA REAKCIONO VREME I EFIKASNOST U DEFANZIVI U FUDBALU

Svako kašnjenje prilikom donošenja rešenja u igri, u velikoj meri umanjuje efikasnost fudbalera prilikom takmičarskih aktivnosti. Cilj ovog istraživanja je da se ispita uticaj instrukcija na efikasnost odbrane. Efikasnost odbrane je procenjivana ostvarenim vremenom reagovanja ispitanika u kvazi - specifičnim fudbalskim situacijama igre 1vs1, upotrebom video metoda. Uzorak ispitanika je činilo 20 osoba muškog pola, podeljenih u dve jednake grupe vrhunskih fudbalera i studenata. Rezultati istraživanja su pokazali da vrhunski fudbaleri imaju efikasniju odbrambenu strategiju u odnosu na studente uz značajne razlike uočene prilikom prezentovanja stimulusa bez fintirajućeg pokreta (F=7,190, p=0,015). Razlike nisu bile značajne nakon odgovora na stimulus sa fintirajućim pokretom (F=0,348, p =0,563), ali treba napomenuti da su u tri od četiri slučaja fudbaleri imali neznatno kraće prosečno vreme reakcije. Ipak rezultati istraživanja su pokazali da eksperimentalna instrukcija nije imala uticaja na efikasnost odbrane prilikom prezentovnja jednostavnih stimulusa (F=2,281, p=0,148), kao ni prilikom prikazivanja složenijih stumulusa sa finitrajućim pokretom (F=1,170, p=0,294). Instrukcija ima značjano mesto u obuci mladih igrača, ali na efikasnost odbrne vrhunskih igrača utiče utreniranost koja se ispoljava usvojenim mehanizmima usled treninga. Prema tome, zaključuje se da davanje instrukcija mora biti u sklopu individualnog pristupa u odnosu na nivo veština osobe kojoj se saopštava.

Ključne reči: *motorna kontrola, brzina reagovanja, video metod, dribbling*