

The Attention As a Key Element to Improve Tactical Behavior Efficiency of Young Soccer Players

Marcelo Odilon Cabral de Andrade^{1,2}, Sixto González-Villora³, Filipe Casanova^{4,5} and Israel Teoldo⁶

Abstract

The aim of this study was to examine the associations between attention and tactical behavior efficiency of young soccer players with similar formal practice time and competitive level. The sample consisted of 80 young male soccer players from Brazilian clubs. The Vienna Test System was used to assess players' attention. The System of Tactical Assessment in Soccer (FUT-SAT) was used to assess players' tactical behavior efficiency. The Generalized Linear Models were used to verify the associations between attention and tactical behavior efficiency. The results showed that attention is positively associated with tactical behavior efficiency of young soccer players. Based on the results, high levels of attention will enable young soccer players with similar formal practice time and competitive level to display better responses regarding the tactical actions of the game.

Keywords: cognition, football, tactics, training process, youth sport psychology.

Attention is one of the most investigated perceptual-cognitive skills in sports, especially in soccer, since it pervades virtually all aspects of perception, cognition, and action (Abernethy, Maxwell, Masters, Kamp and Jackson, 2007). According to Williams, Davids and Williams (1999), attention is related to the process by which certain relevant information is processed whilst other information is ignored. Thus, studies involving attention in soccer have indicated that players with better performance are those who manage to be attentive among the various stimuli present in the environment (Faubert, 2013; Mora, Zarco and Blanca, 2001; Williams and Davids, 1998).

Due to the great amount of information in a soccer game, high levels of attention are required of players in order that responses can be provided more efficiently (Garganta, Guilherme, Barreira, Brito and Rebelo, 2013). Therefore, more attentive players have the ability to select the relevant information to which the efforts will be directed, ignoring the stimuli considered irrelevant for the game (Carr, Etnier and Fisher, 2013; Memmert, Simons and Grimme, 2009). Consequently, this ability is dependent on the levels of knowledge and experience in performing specific tasks of the soccer game (Scharfen and Memmert, 2019; Ward, Ericsson and Williams, 2013).

In this sense, studies regarding attention in soccer highlight the differences between players with different levels of experience in formal practices (Carr et al., 2013; Williams and Davids, 1998), and competitive levels (Faubert, 2013; Ford, Hodges and Williams, 2005; Verburgh, Scherder, Lange and Oosterlaan, 2014). For instance, Williams and Davids (1998) reported that more experienced players displayed better levels of attention in comparison to less experienced ones. These more attentive players had better performance in “1 vs. 1” and “3 vs. 3” small-sided games, extracting more information from the positioning of opponents, teammates and spaces on the playing field. In addition, Faubert (2013) reported similar results, as he acknowledged that players who competed at higher competitive levels were quicker and more accurate in dealing with complex and dynamic visual scenes when compared to players who played in lower competitive levels. Thus, it is possible to postulate that attention levels are positively related to expertise, in addition to being an important ability to qualify players' responses (Mann, Williams, Ward and Janelle, 2007).

With the growing interest in identifying which responses are associated with the performance in soccer, the assessment of players' tactical behavior has been deemed essential to understand how players manage the playing space (Teoldo, Oliveira and Garganta, 2015). According to

1 Centre of Research and Studies in Soccer, Universidade Federal de Viçosa, Brazil. Correspondence Author: Marcelo Odilon Cabral de Andrade - Centre of Research and Studies in Soccer - Departamento de Educação Física - Universidade Federal de Viçosa - Av. P. H. Rolfs, S/N. Campus Universitário. Post Code: 36.570-900, Viçosa, Minas Gerais, Brazil. Tel: +553136125429. E-mail: mocabral.andrade@gmail.com

2 Faculty of Viçosa (FDV), Brazil.

3 Faculty of Education (Cuenca), University of Castilla-La Mancha, Spain.

4 Center of Research, Education, Innovation and Intervention in Sport (CIFID), Faculty of Sport (FADEUP), University of Porto, Portugal.

5 University Lusófona of Porto, Portugal.

6 Centre of Research and Studies in Soccer, Universidade Federal de Viçosa, Brazil.

literature, players can better manage the specific situations of a match when they are efficient in performing tactical behaviors (Garganta et al., 2013; Teoldo et al., 2015). In this sense, this ability should be developed with different skills at the early ages of the formation in soccer (González-Villora, García-López, Pastor-Vicedo and Contreras-Jordán, 2011; Larkin, O'Connor and Williams, 2016).

Accordingly, many years of both formal practices and high-level competitions in soccer are required for players to be more efficient in employing perceptual-cognitive skills, such as attention, to perform tactical actions in the game (Casanova, Oliveira, Williams and Garganta, 2009; Côté, Lidor and Hackfort, 2009; Ford, Ward, Hodges and Williams, 2009; Gonçalves et al., 2017). Thus, studies regarding attention in soccer have shown that this skill is positively associated with the performance of more experienced soccer players, as well as those who play at higher levels (Faubert, 2013; Williams and Davids, 1998). However, these studies did not examine the associations between attention and performance of young soccer players with similar formal practice time at the same competitive level, in particular with respect to the utilization of tactical behavior efficiency as a performance criterion.

In this regard, young soccer players generally have limited formal practice time in soccer (Ward et al., 2013). Despite this limitation, attention is an essential skill for young players to learn about the dynamic and complex demands of the soccer game (Memmert, 2009). Thus, investigating attention in a homogeneous group of players who are at the start of the formal training in soccer may indicate the importance of this skill in the initial stages of the teaching-learning process.

Therefore, the aim of this study was to examine the associations between attention and tactical behavior efficiency of young soccer players with similar formal practice time and competitive level. It was hypothesized that even for soccer players with similar formal practice time and competitive level, attention will be positively associated with their tactical behavior efficiency. Specifically, it is expected that high levels of attention will be one of the predictors of tactical behavior efficiency for young soccer players who experience similar training conditions (Ford et al., 2009; Memmert, 2009). These higher levels of attention will enable players to better select information from the environment, thus efficiently managing the playing space, time and making more meaningful learning.

Methods

Participants

The participants were 80 male soccer players of Brazilian clubs (mean age: 13.90 ± 1.08 years). The choice for this sample age is justified due to the fact that the players are in an early phase of refinement of their abilities, but they already have a history of training in formal practices in

soccer. As selection criteria, the players should be engaged in a regular training program (at least three times a week), besides playing in soccer tournaments at the same level (regional level). Moreover, the players should present similar formal practice time in soccer (four years of formal practice in soccer clubs).

Ethical Procedures

All research procedures were conducted in accordance with the norms established by the Resolution of the National Health Council (Conselho Nacional de Saúde, 2012) and by the Declaration of Helsinki (World Medical Association, 2013). The project had the approval of the Ethics Committee for Research with Human Beings (N. 933.270 - CAAE: 38977614.9.0000.5153). The soccer clubs signed a statement of authorization, granting permission for the players who voluntarily met the study's requirements to participate, as well as to the researchers to use the clubs' facilities for testing purposes. In addition, written informed parental consent was obtained for each player.

Experimental Apparatus

Assessment of attention

The cognitrone test (COG - version S4) included in the Vienna Test System was used to assess players' attention (Schuhfried, 2011). The Vienna Test System is a computerized system that enables the assessment of different perceptual-cognitive skills (Hackfort, Kilgallen and Hao, 2009). The cognitrone test is based on the theoretical model of Reulecke (1991), which describes attention through three aspects: i) energy demanded; ii) function in performing a task; and iii) precision in executing determined task.

Assessment of tactical behavior efficiency

The System of Tactical Assessment in Soccer (FUT-SAT) was used to assess players' tactical behavior efficiency (Teoldo, Garganta, Greco, Mesquita and Maia, 2011). This system enables the assessment of tactical actions performed by the players based on ten core principles of the game: i) penetration; ii) offensive coverage; iii) depth mobility; iv) width and length; v) offensive unity; vi) delay; vii) defensive coverage; viii) balance; ix) concentration; x) defensive unity.

In order to assess tactical behavior efficiency, the FUT-SAT field test – GK+3 vs. 3+GK (goalkeeper + 3 players vs. 3 players + goalkeeper) was conducted with the utilization of the offside rule. In this field test, soccer small sided-games are filmed in a specific area (36 meters length by 27 meters wide). For the recording of the games, a SONY™ (model HDR-XR100) video camera was used. The resultant video footage was transferred to an HP Pavilion G4 laptop, Intel Core™ i3 processor, and converted to “.avi” files through Format Factory for Windows™. In order to analyze the games after data collection, the software Soccer Analyser™ was used. As a

means to control the formal practice time, players responded to the FUT-SAT's sample characterization questionnaire. In this questionnaire, the players were asked to inform the time in which they spent in formal soccer practices.

Data Collection Procedures

Assessment of attention

In an individual room, the player should sit in front of a computer screen. Four pictures were presented at the top, and one picture at the bottom of the screen. During the test the player was asked to identify, as quickly as possible, whether the picture at the bottom of the screen was presented in one of the four pictures at the top of the screen. The pictures were randomly changed at a fixed interval of 1.8 seconds. If the player identified the correspondence between the top and bottom pictures, the green button on the response panel of the Vienna Test System should be pressed as quickly as possible. If the player did not identify the correspondence between the top and bottom pictures, the green button should not be pressed on the response panel. Before the start of the test, the player performed task-learning drills for 30 seconds, whereas the duration of the test was around 6 minutes.

The main measures provided by the cognitrone test are the following: i) total correct reactions (total number of trials in which the green button was pressed after the identification of correspondence between pictures); ii) total incorrect reactions (total number of trials in which the green button was pressed after the non-identification of correspondence between the pictures); and iii) total incorrect non-reactions (total number of trials in which the green button was not pressed after the identification of equity between the pictures).

Assessment of tactical behavior efficiency

Games between two teams with three players each and their respective goalkeepers (all players with numbered vests) were filmed. The players are asked to play for four minutes according to the laws of the game, including the offside rule. Prior to the start of the test, 30 seconds were conceded to the players for familiarization with GK+3 vs. 3+GK situation. During the test, there was no verbal interference by the coaches, nor by the researchers.

After obtaining video footage, the tactical actions performed by the players during the game were observed and analyzed by trained evaluators in the FUT-SAT. According to Teoldo and colleagues (2011), the three steps for the analysis of the game with FUT-SAT comprise: (i) the analysis of the actions performed by the player during the game; (ii) the assessment, classification and recording of tactical actions; and (iii) the calculation of the variables in the categories tactical performance index, tactical actions, percentage of errors and place of action related to the principle. To calculate tactical behavior efficiency, the assessment takes into account the frequency of execution

of tactical actions and their success rate - the accuracy percentage in the tactical actions performed by the players.

Data Analysis

Descriptive analysis (means and standard deviations/errors) was performed for gathering information about the sample.

The Generalized Linear Models (GLMs) under binomial errors were used to verify the association between attention parameters (x-var) and tactical behavior efficiency (y-var). The attention's measures were described by a) total correct reactions (x-var1), b) total incorrect reactions (x-var2), and c) total incorrect non-reactions (x-var3) in the cognitrone test. The tactical behavior efficiency was estimated using the accuracy percentage of the tactical actions performed by the players during the FUT-SAT's game. The binomial family is suitable for proportion and percentage data (Crawley, 2007). After model building, it was performed a residual analysis to verify the suitability of the model and the error distribution. It was also included the formal practice time of players as a covariate in the model. This was necessary because the participants of this study should present similar formal practice time, being the formal practice time a variable that could not influence the levels of attention and tactical behavior efficiency of soccer players in this study. For the effect size, Cohen's f^2 analyses were performed, which is suitable for regression models (Selya, Rose, Dierker, Hedeker and Mermelstein, 2012).

Possible outliers in the model were tested using the Cook's Distance using the package "Ggally". The R statistical software (R Core Team, 2018) was used for all statistical procedures. The significance level adopted was set at $p < .05$.

For the data regarding tactical behavior efficiency, the test-retest method (Cohen's Kappa) was used to verify the reliability coefficient for the analysis performed by the observers. Reliability analyses were performed after a three-week interval, so as to avoid issues related to task familiarity (Robinson and O'Donoghue, 2007). From 8208 tactical actions, 882 were reassessed, which represents 10.74% of the sample, a value higher than that (10.00%) indicated by the literature (Tabachnick and Fidell, 2007). Two external observers participated in this procedure, and reliability values were between 0.818 (SE=0.054) and 1.000 (SE=0.000) for intra-observer reliability, and between 0.828 (SE=0.065) and 1.000 (SE=0.000) for inter-observer reliability. These values demonstrated a high degree of agreement between the observers.

Results

Descriptive analysis with the results of means, deviations, and errors of the measures used in this study is presented in Table 1. Attention is represented by the measures "total correct reactions", "total incorrect reactions", and "total incorrect non-reactions". Tactical behavior efficiency is represented by the measure "accuracy percentage of the tactical actions".

Table 1

Means, deviations, and errors of the measures representing attention and tactical behavior efficiency of the players.

Measure	Mean	Standard Deviation	Standard Error
COG - total correct reactions	57.86	7.96	0.89
COG - total incorrect reactions	31.29	11.19	1.25
COG - total incorrect non-reactions	22.14	7.96	0.89
FUT-SAT - accuracy percentage of the tactical actions	81.59	9.37	1.05

The results of the association between attention (total correct reactions in cognitrone test) and tactical behavior efficiency (accuracy percentage of the tactical actions) are displayed in Figure 1. Performing the GLMs, the results indicated that attention levels of soccer players for this parameter are positively associated with their tactical

behavior efficiency [$F(1,78) = 11.441; p < 0.001$]. Subsequently, it was verified that the formal practice time did not influence attention and tactical behavior efficiency of soccer players [$F(1,77) = 0.1944; p = 0.665$]. The Cohen's f^2 effect size of this model was 0.15 (medium).

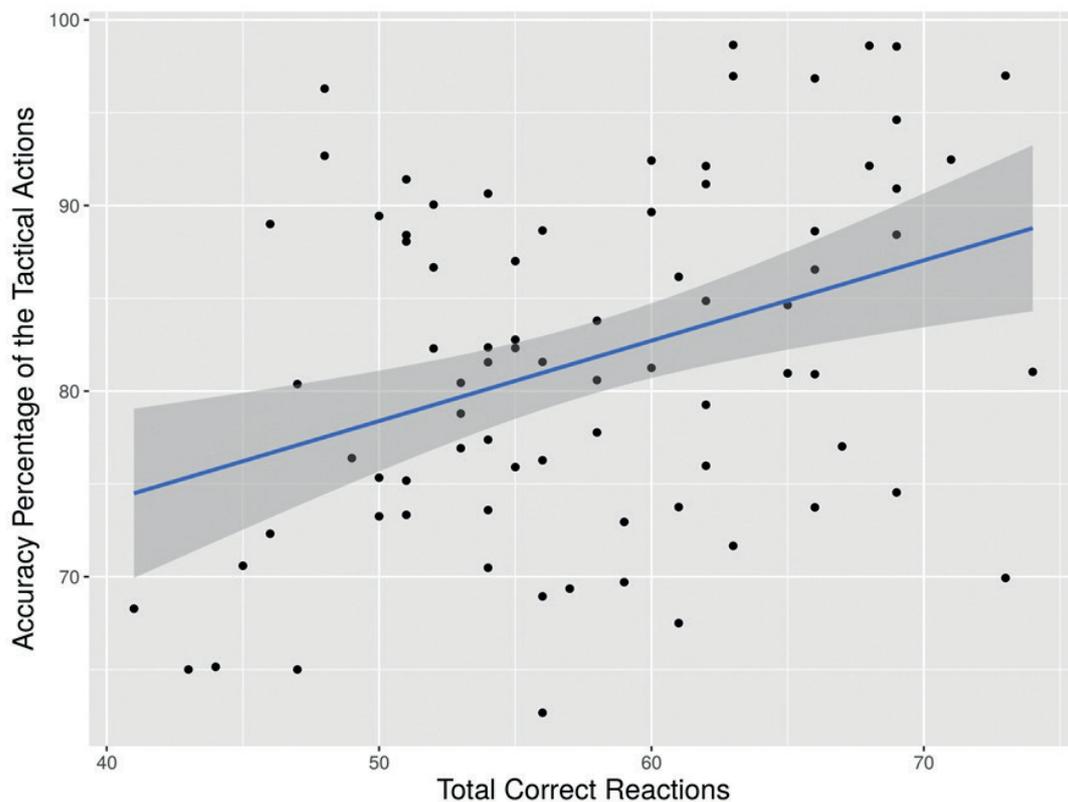


Figure 1. Association between attention and tactical behavior efficiency. The variable “Total Correct Reactions” affected the “Accuracy Percentage of the Tactical Actions” ($p < 0.001$). Each dot represents a single player.

In order to display the association between attention (total incorrect reactions in cognitrone test) and tactical behavior efficiency (accuracy percentage of the tactical actions), the results are shown in Figure 2. Performing the GLMs, the results indicated that attention levels of soccer players for this parameter were not associated with their

tactical behavior efficiency [$F(1,78) = 0.0151; p = 0.902$]. The formal practice time did not influence attention and tactical behavior efficiency of soccer players [$F(1,77) = 0.0092; p = 0.924$]. The Cohen's f^2 effect size of this model was 0.006 (small).

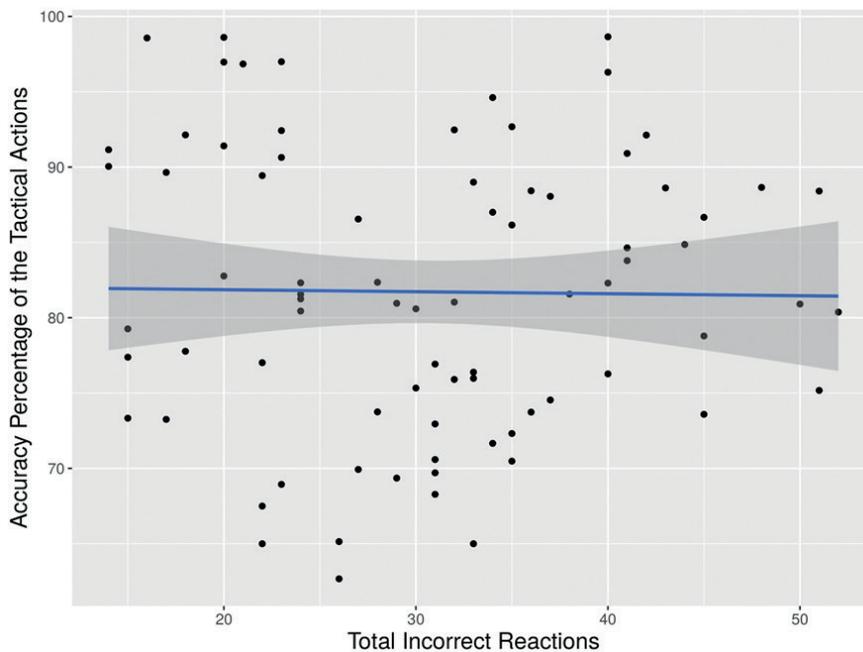


Figure 2. Association between attention and tactical behavior efficiency. The variable “Total Incorrect Reactions” did not affect the “Accuracy Percentage of the Tactical Actions” ($p = 0.902$). Each dot represents a single player.

Regarding the association between attention (total incorrect non-reactions in cognitrone test) and tactical behavior efficiency (accuracy percentage of the tactical actions), the results are shown in Figure 3. Performing the GLMs, the results indicated that attention levels of soccer players for this parameter are positively associated with their

tactical behavior efficiency [$F(1.78) = 11.441$; $p < 0.001$]. Subsequently, it was verified that the formal practice time did not influence attention and tactical behavior efficiency of soccer players [$F(1.77) = 0.1944$; $p = 0.665$]. The Cohen’s f^2 effect size of this model was 0.15 (medium).

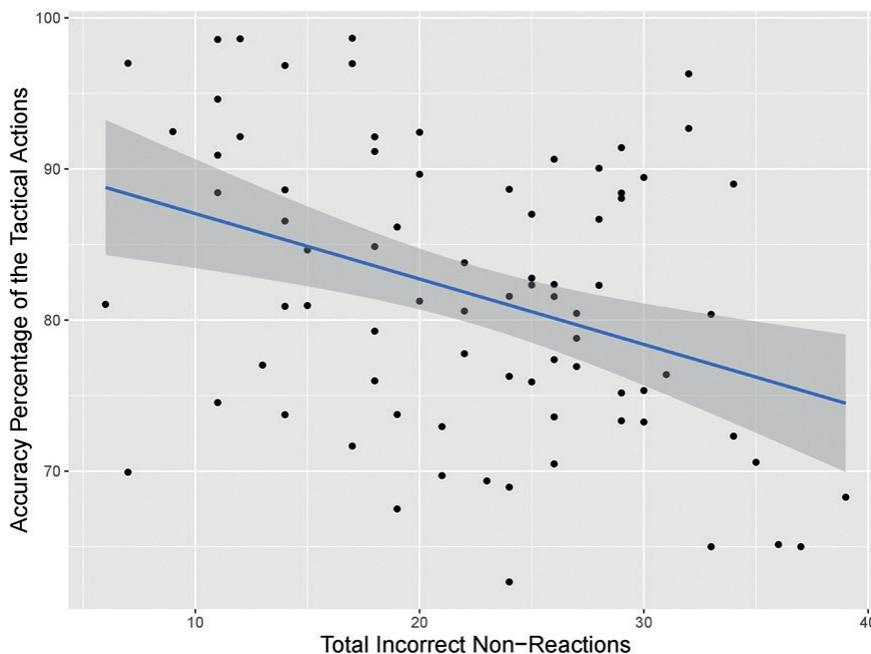


Figure 3. Association between attention and tactical behavior efficiency. The variable “Total Incorrect Non-Reactions” affected the “Accuracy Percentage of the Tactical Actions” ($p < 0.001$). Each dot represents a single player.

Discussion

This study proposed to examine the associations between attention and tactical behavior efficiency of young soccer players with similar formal practice time and competitive level. Through the control of formal practice time and competitive level, the results indicated that attention is positively associated with the tactical behavior of soccer players. With respect to the measures “total correct reactions” and “total incorrect non-reactions”, players with high levels of attention were tactically more efficient. Thus, it was confirmed the hypothesis that attention would be one of the predictors of tactical behavior efficiency for young soccer players who experience similar training conditions.

Based on these results, attention is also essential for young soccer players with similar formal practice time at the same competitive level to achieve better performances in the game. Players with high levels of attention are more able to select the best information from the game, ignoring stimuli that are irrelevant for the increase of performance (e.g. external factors to the game) (Ford et al., 2005; Williams, Ward, Bell-Walker and Ford, 2012). Thus, with more accurate information selection mechanisms due high-level attention, players are more able to deal with complex and dynamic visual stimuli, thus being more efficient in performing tactical behaviors (Faubert, 2013; Garganta et al., 2013).

With the lack of studies that investigated the differences in attention according to the tactical behavior efficiency of young soccer players with similar formal practice time and competitive level, the results of this study advance in the identification of the importance of developing attention in the early stages of soccer training. Likewise, attention is positively associated with the expertise of soccer players, and this association also appear in players with similar formal practice time and competitive level. Thus, developing the players’ attention at the beginning of systematized training in soccer is essential for players learning about the game and for improving performance.

In this regard, the features of the sample of this study may explain this result, since the players are at beginning of the training process. According to the literature, players who are at the start of their development are characterized by having limited formal practice time in soccer (Vänttinen, Blomqvist, Luhtanen and Häkkinen, 2010; Ward et al., 2013). Hence, other types of soccer activities (e.g. informal practices) may contribute to the players’ attention development (Ford et al., 2009). These other types of practice become relevant since players at initial training stages are in a latent phase of development of attentional skills (Memmert, 2009). Therefore, through activities other than formal practice in soccer, players may have been encouraged to maintain high levels of attention to perform tasks, implying a further development of this ability (Ford et al., 2009; Januário, Rosado, Mesquita, Gallego and Aguilar-Parra, 2016).

Furthermore, it is important to report that for the “total incorrect reactions” measure, attention was not associated with tactical behavior efficiency of the players. The age group of the participants in this study may explain this result. In this respect, the literature indicates that the ability to inhibit prepotent responses increases considerably throughout adolescence, as this ability is related to the maturation of the prefrontal cortex, which occurs until adulthood (Casey and Jones, 2010; Niv, Tuvblad, Raine, Wang and Baker, 2012). Thus, players in the initial stages of development have difficulties to inhibit behaviors considered impulsive. However, although this error is common in players of this sample, the more tactically efficient players reacted more assertively than the less tactically efficient ones.

From the results presented and discussed, it is possible to acknowledge the importance of attention for soccer players’ performance. Like previous research findings that investigated attention according to experience in formal practice and competitive levels in soccer (Faubert, 2013; Verburch et al., 2014; Williams and Davids, 1998), this skill is positively associated with the performance of young players with similar formal practice time at the same competitive level. Therefore, although the players assessed have access to similar systematized training programs, there are differences between them in the acquisition of skills during soccer training, especially when taking into account their attentional levels. These differences can be related to several aspects present in the process of young player formation (for example, the relative age effects), in which the players may be in different stages of the maturational process (Gonçalves et al., 2017; Teoldo, Garganta, Greco, Mesquita and Seabra, 2010).

As for practice, results of the present research indicate the importance of training attention in young soccer players with similar formal practice time and competitive level. Although young players may be in a homogeneous group, an inefficient attention training can imply in different learning for these players. Thus, the training will not be effective since the players will not understand the drills that require high attentional demand.

For future research, it is suggested the control of players’ history of informal practices during the evaluations, with the purpose of verifying the influence of this type of practice on players’ attention. In addition, studies involving attention and tactical aspects should be conducted in homogeneous groups of different ages, in order to verify how these variables are related to performance in other stages of soccer development.

In conclusion, the findings of this study indicate that attention is positively associated with tactical behavior efficiency of young soccer players with similar formal practice time and competitive level. Specifically, players that are more attentive displayed better performance with respect to tactical behavior efficiency. Thus, the present study contributes to the progress of research on attention,

by verifying the relation of this variable to the tactical actions of players over the development process.

Acknowledgements

The authors wish to acknowledge the contribution of Rodrigo Santos for his English review of the manuscript. The authors also wish to acknowledge the contribution of Vinícius Rodrigues for his support in statistical procedures.

Financial support

This work was supported by SEESP-MG through the LIE, FAPEMIG, CNPq, FUNARBE, the Dean's Office for Graduate and Research Studies and the Centre of Life and Health Sciences from the Universidade Federal de Viçosa, Brazil. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

La atención como elemento clave para mejorar la eficiencia del comportamiento táctico de los futbolistas jóvenes

Resumen

El objetivo del estudio fue verificar las asociaciones entre la atención y la eficiencia del comportamiento táctico de jóvenes jugadores de fútbol con tiempo de práctica formal y nivel competitivo similares. La muestra consistió en 80 jugadores de fútbol jóvenes del sexo masculino de clubes de Brasil. El *Vienna Test System* fue utilizado para evaluar la atención de los jugadores. El Sistema de Evaluación Táctica en el Fútbol (FUT-SAT) fue utilizado para evaluar la eficiencia del comportamiento táctico de los jugadores. Los Modelos Lineales Generalizados se utilizaron para verificar las asociaciones entre la atención y la eficiencia del comportamiento táctico. Los resultados revelaron que la atención está positivamente asociada a la eficiencia del comportamiento táctico de jóvenes jugadores de fútbol. Basado en estos resultados, altos niveles de atención permitirán que los jóvenes jugadores con tiempo de práctica formal y nivel competitivo similares presenten mejores respuestas en relación a las acciones tácticas en el juego.

Palabras clave: cognición; fútbol; táctica; proceso de entrenamiento; psicología del deporte en la juventud.

A atenção como elemento chave para melhorar a eficiência do comportamento tático de jovens jogadores de futebol

Resumo

O objetivo deste estudo foi verificar as associações entre a atenção e a eficiência do comportamento tático de jovens jogadores de futebol com tempo de prática formal e nível competitivo similares. A amostra foi composta por 80 jogadores de futebol jovens do sexo masculino de clubes do Brasil. O *Vienna Test System* foi utilizado para avaliar a atenção dos jogadores. O Sistema de Avaliação Tática no Futebol (FUT-SAT) foi utilizado para avaliar a eficiência do comportamento tático dos jogadores. Os Modelos Lineares Generalizados foram utilizados para verificar as associações entre a atenção e a eficiência do comportamento tático. Os resultados mostraram que a atenção está positivamente associada à eficiência do comportamento tático de jovens jogadores de futebol. Baseado nesses resultados, altos níveis de atenção irão permitir que jovens jogadores com tempo de prática formal e nível competitivo similares apresentem melhores respostas em relação às ações táticas no jogo.

Palavras-chave: cognição; futebol; tática; processo de treino; psicologia do esporte na adolescência.

References

- Abernethy, B., Maxwell, J. P., Masters, R. S. W., Kamp, J. V. D. and Jackson, R. C. (2007). Attentional processes in skill learning and expert performance. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of Sport Psychology* (3 ed., pp. 245-263). New Jersey: John Wiley & Sons.
- Carr, B. M., Etnier, J. L. and Fisher, K. M. (2013). Examining the time course of attention in a soccer kick using a dual task paradigm. *Human Movement Science*, 32(1), 240-248. doi: 10.1016/j.humov.2012.12.006
- Casanova, F., Oliveira, J., Williams, M. and Garganta, J. (2009). Expertise and perceptual-cognitive performance in soccer: a review. *Revista Portuguesa de Ciências do Desporto*, 9(1), 115-122. doi: 10.5628/rpcd.09.01.115
- Casey, B. and Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior. *Journal of the American Academy of Child and Adolescent Psychiatry*, 49(12), 1189-1285.
- Conselho Nacional de Saúde. (2012). *Diretrizes e normas regulamentadoras de pesquisa envolvendo seres humanos*. Resolução n. 466, de 12 de dezembro de 2012, Brasília, Brasil: Ministério da Saúde.
- Côté, J., Lidor, R. and Hackfort, D. (2009). ISSP position stand: To sample or to specialise? Seven postulates about youth sport activities that lead to continued participation and elite performance. *International Journal of Sport and Exercise Psychology*, 9(1), 7-17. doi: 10.1080/1612197X.2009.9671889
- Crawley, M. J. (2007). *The R Book*. London, U.K. : John Wiley & Sons.

- Faubert, J. (2013). Professional athletes have extraordinary skills for rapidly learning complex and neutral dynamic visual scenes. *Scientific Reports*, 3, 1154. doi: 10.1038/srep01154
- Ford, P., Hodges, N. J. and Williams, A. M. (2005). Online attentional-focus manipulations in a soccer-dribbling task: Implications for the proceduralization of motor skills. *Journal of Motor Behavior*, 37(5), 386-394.
- Ford, P. R., Ward, P., Hodges, N. J. and Williams, A. M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies*, 20(1), 65-75. doi: 10.1080/13598130902860721
- Garganta, J., Guilherme, J., Barreira, D., Brito, J. and Rebelo, A. (2013). Fundamentos e práticas para o ensino e treino do futebol. In F. Tavares (Ed.), *Jogos desportivos coletivos: ensinar a jogar* (pp. 199-264). Porto: FADEUP.
- Gonçalves, E., Noce, F., Barbosa, M. A. M., Figueiredo, A. J., Hackfort, D. and Teoldo, I. (2017). Correlation of the peripheral perception with the maturation and the effect of the peripheral perception on the tactical behaviour of soccer players. *International Journal of Sport and Exercise Psychology*, 1-13. doi: 10.1080/1612197X.2017.1329222
- González-Villora, S., García-López, L. M., Pastor-Vicedo, J. C. and Contreras-Jordán, O. R. (2011). Tactical knowledge and decision making in young football players (10 years old). *Revista de Psicología del Deporte*, 20(1), 79-97.
- Hackfort, D., Kilgallen, C. and Hao, L. (2009). The action theory-based mental test and training system (MTTS). In T. M. Hung, R. Lidor & D. Hackfort (Eds.), *Psychology of sport excellence: International perspectives on sport and exercise psychology* (Vol. 1, pp. 15-24): Morgantown: Fitness Information Technology.
- Januário, N., Rosado, A., Mesquita, I., Gallego, J. and Aguilar-Parra, J. M. (2016). Determinants of feedback retention in soccer players. *Journal of Human Kinetics* 51, 235-241. doi: 10.1515/hukin-2015-0187
- Larkin, P., O'Connor, D. and Williams, A. M. (2016). Does Grit Influence Sport-Specific Engagement and Perceptual-Cognitive Expertise in Elite Youth Soccer? *Journal of Applied Sport Psychology*, 28(2), 129-138.
- Mann, D. T. Y., Williams, A. M., Ward, P. and Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: a meta-analysis. *Journal of Sport and Exercise Psychology*, 29(4), 457-478.
- Memmert, D. (2009). Pay attention! A review of visual attentional expertise in sport. *International Review of Sport and Exercise Psychology*, 2(2), 119-138.
- Memmert, D., Simons, D. J. and Grimme, T. (2009). The relationship between visual attention and expertise in sports. *Psychology of Sport and Exercise*, 10(1), 146-151. doi: 10.1016/j.psychsport.2008.06.002
- Mora, J. A., Zarco, J. A. and Blanca, M. J. (2001). Atención-concentración como entrenamiento para la mejora del rendimiento deportivo en jugadores profesionales de fútbol. *Revista de Psicología del Deporte*, 10(1), 49-65.
- Niv, S., Tuvblad, C., Raine, A., Wang, P. and Baker, L. A. (2012). Heritability and longitudinal stability of impulsivity in adolescence. *Behavior Genetics*, 42(3), 378-392.
- R Core Team. (2018). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.
- Reulecke, W. (1991). Konzentration als trivalente Performanzvariable - theoretische Prämissen, Rastermodell und empirisches Umsetzungsbeispiel. In J. Janssen, E. Hahn & H. Strang (Eds.), *Konzentration und Leistung* (pp. 63-73): Göttingen: Hogrefe.
- Robinson, G. and O'Donoghue, P. G. (2007). A weighted kappa statistic for reliability testing in performance analyses of sport. *International Journal of Performance Analysis in Sport*, 7(1), 12-19. doi: 10.1080/24748668.2007.11868383
- Scharfen, H. E. and Memmert, D. (2019). Measurement of cognitive functions in experts and elite athletes: A meta-analytic review. *Applied Cognitive Psychology*, 1-18. doi: 10.1002/acp.3526
- Schuhfried, G. (2011). Cognitrone. In D. Kallweit (Ed.), *Vienna Test System: Psychological assessment* (pp. 57). Mödling: Paul Gerin Druckerei, Wolkersdorf.
- Selya, A. S., Rose, J. S., Dierker, L. C., Hedeker, D. and Mermelstein, R. J. (2012). A practical guide to calculating Cohen's f^2 , a measure of local effect size, from PROC MIXED. *Frontiers in Psychology*, 3, 111. doi:10.3389/fpsyg.2012.00111
- Tabachnick, B. and Fidell, L. (2007). *Using Multivariate Statistics* (Vol. 5). New York: Harper e Row Publishers.
- Teoldo, I., Garganta, J., Greco, P. J., Mesquita, I. and Maia, J. (2011). System of tactical assessment in soccer (FUT-SAT): Development and preliminary validation. *Motricidade*, 7(1), 69-83. doi: 10.6063/motricidade.7(1).121
- Teoldo, I., Garganta, J., Greco, P. J., Mesquita, I. and Seabra, A. (2010). Influence of relative age effects and quality of tactical behaviour in the performance of youth soccer players. *International Journal of Performance Analysis of Sport*, 10, 82-97. doi: 10.1080/24748668.2010.11868504
- Teoldo, I., Oliveira, J. G. and Garganta, J. (2015). *Training football for smart playing: on tactical performance of teams and players* (Vol. 1). Curitiba: Appris.
- Vänttinen, T., Blomqvist, M., Luhtanen, P. and Häkkinen, K. (2010). Effects of age and soccer expertise on general tests of perceptual and motor performance among adolescent soccer players. *Perceptual and Motor Skills*, 110(3), 675-692. doi: 10.2466/pms.110.3.675-692
- Verburgh, L., Scherder, E. J. A., Lange, P. A. M. v. and Oosterlaan, J. (2014). Executive functioning in highly talented soccer players. *Plos One*, 9(3), e91254.

- Ward, P., Ericsson, K. A. and Williams, A. M. (2013). Complex perceptual-cognitive expertise in a simulated task environment. *Journal of Cognitive Engineering and Decision Making*, 7(3), 231-254. doi: 10.1177/1555343412461254
- Williams, A. M. and Davids, K. (1998). Visual search strategy, selective attention, and expertise in soccer. *Research Quarterly for Exercise and Sport*, 69(2), 11-128.
- Williams, A. M., Davids, K. and Williams, J. G. (1999). *Visual perception and action in sport*: London: E & FN Spon.
- Williams, A. M., Ward, P., Bell-Walker, J. and Ford, P. R. (2012). Perceptual-cognitive expertise, practice history profiles and recall performance in soccer. *British Journal of Psychology*, 103(3), 393-411. doi: 10.1111/j.2044-8295.2011.02081.x
- World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA*, 310(20), 2191-2194. doi: 10.1001/jama.2013.281053