Rev Bras Cineantropom Hum

original article

DOI: http://dx.doi.org/10.5007/1980-0037.2016v18n3p362

The influence of technical skills on decision making of novice volleyball players

A influência da habilidade técnica na tomada de decisão de jogadores iniciantes de voleibol

Mariana Calábria Lopes[1]
Raiane Teixeira Magalhães[1]
Laura Beatriz Faleiro Diniz[1]
João Paulo Abreu Moreira[1]
Maicon Rodrigues Albuquerque[1]

Abstract – The aim of this study was to verify the influence of the technical skills level on the decision making of novice volleyball players on service, reception and set actions. The sample was composed of 80 novice athletes of school volleyball teams of both sexes. Based on the results from the Volleyball Skills Test Battery, the sample was divided into three groups: low, intermediate and high technical level, by means of One-Way ANOVA. The intermediate group was excluded from further analyses. Decision making was assessed with the Game Performance Assessment Instrument (GPAI). For data analysis purposes, the independent student-*t* test was used, adopting significance level of $p \leq 0.05$. The results showed that players with low skill level in service and set actions also had lower performance on the decision-making test when compared to players with high technical level. On the other hand, in the reception action, no differences were found among groups. It was therefore concluded that the technical level seems to influence the decision making in service and set actions in novice volleyball players.

Key words: Adolescent; Cognition; Sports.

Resumo – *O estudo objetivou verificar a influência do nível da habilidade técnica na tomada de decisão de jogadores iniciantes de voleibol nas ações de saque, recepção e levantamento. A amostra foi composta por 80 atletas iniciantes de equipes escolares de voleibol de ambos os sexos. Com base nos resultados na Bateria de Testes de Habilidades de Voleibol, a amostra foi dividida em três grupos: baixo, intermediário e alto nível técnico, por meio da ANOVA One-Way. O grupo intermediário foi excluído das análises posteriores. A tomada de decisão foi avaliada por meio do Game Performance Assessment Instrument (GPAI). Utilizou-se o teste t student independente para análise dos dados, adotando um nível de significância de p≤0,05. Os resultados encontrados demonstraram que os jogadores com baixo nível de habilidade nas ações de saque e levantamento, também obtiveram um pior desempenho no teste de tomada de decisão quando comparado aos jogadores de alto nível técnico. Por outro lado, na ação de recepção, não foram encontradas diferenças significativas entre os grupos. Conclui-se que o nível técnico parece influenciar na tomada de decisão na ação de saque e levantamento dos jogadores iniciantes de voleibol.*

Palavras-chave: *Adolescente; Cognição; Esportes.*

1 Federal University of Viçosa. Department of Physical Education. Viçosa, MG. Brazil.

Received: 02 February 2016
Accepted: 28 April 2016

INTRODUCTION

Competitive sports using nets like badminton and volleyball require the athlete to receive and return the moving game object in a single action, since it cannot touch the ground or be retained[1]. In addition, in volleyball , the mandatory rotation of players by the positions on the court always form six different compositions of the team in the game space, which relates to different opponent's organizations. The key to success in these sports involves choosing the best decision ("what to do") and the implementation of the correct technique ("how to do") in a very short time and very accurately[2]. These two components can hardly be disassociated, since the way the player analyzes the game situations and makes his decisions depends on how he perceives and conceives the game.

A considerable number of studies involving individual differences between novice and experts athletes regarding motor and cognitive aspects have been carried out in recent years (for review see Farrow et al.[3]). However, few studies aimed to investigate how action (technical) and cognition (decision making) directly interact in real sporting environments[2]. Quantification and specification of the effects of action on cognition have different important practical consequences such as improved performance in problem solving[4] and creativity promotion[5].

One of the main reasons for the limited number of studies that attempted to determine the relationship between decision-making and technique is related to methodological aspects[6]. One of the most common methods for decision making assessment is based on the analysis of videos in which the cognitive component is dissociated from the motor action and has little ecological validity when compared to tests in real environments[7]. Tests in which the subject has the possibility to see the opponent "live" and perform the response through movements have shown to be more sensitive and reliable measures to the sporting environment when compared to laboratory situations, which only require a verbal, written or non-interactive response[8].

Thus, an issue that still remains unanswered in literature is related to how technical skills influence the decision-making process[9]. Johnson[10] suggests that this relationship can occur in one or more primary forms such as: (a) beginning or modification of the subjective evaluation or the perception of action courses in order to be in cognitive tune; (b) restrictions, for a moment, of the subject's focus of attention based on physical orientation and; (c) alteration of options that can be found within the group of choices, or those seriously considered as executable. Thus, in some cases, the "best" solution or decision is not chosen for being beyond the subject's technical skill level[10,11]. For example, a volleyball player is aware that, in a particular game situation, his best option would be to attack the ball in parallel. However, if he is not able to perform this type of motor action, he will eventually choose another solution, despite knowing that this is not the best decision-making at that time.

The only work found in literature in which motor ability was directly assessed as well as its influence on decision-making in real game situations

was the study by Bruce et al.[9], which compared different levels of expertise in the netball modality. The results showed that less skilled athletes achieved lower performance in decision-making test with concomitant motor execution in real game situation when compared to more skilled players. However, the motor skill level did not limit the decision-making nature when it was analyzed in isolation (without motor performance), and players at lower technical levels chose, in some situations, to perform long passes, even not having a good mastering of the technique.

However, one cannot state this assumption due to the few studies found on the topic. Moreover, the study by Bruce et al.[9] was conducted with adults, whereas the group of beginners had on average 5.3 years (± 4.0) of experience in the modality, which according to the definition of expert[12] (minimum 10 years of practice), the subjects would already be at an intermediate stage of the formation process. Thus, studies aimed at analyzing the influence of the technique on the decision making of novice players should be carried out. A better understanding of this relationship can assist coaches in evaluating the technical and tactical knowledge of the player, as well as organization and practical planning, making training more specific to meet the needs and skills of athletes.

In this sense, the aim of this study was to determine the effect of the technical skill level on the decision making of volleyball beginners in serve, reception and set actions.

METHODOLOGICAL PROCEDURES

Sample

The study included 80 adolescents, members of four school volleyball teams. The sample was composed of 29 male (36.3%) and 51 female subjects (63.7%). The average age of subjects participating in the sample was 13.85 ± 1.62 years, with average volleyball practice time of 1.90 ± 1.71 years. In relation to the scope of competition, 63.4% had competed in school championships at municipal level and 36.4% at state level.

Based on the values obtained by subjects in the technical skills test (see section of instruments), the sample was stratified into tertiles for comparison effect: 1st tertile (T1) - low technical level; 2nd tertile (T2) - moderate technical level; 3rd tertile (T3) - high technical level. Table 1 shows the values of each group in technical skills test and the results of the One-Way ANOVA test for the comparison of the technical level among the three groups. The results showed statistically significant differences for technical skills such as serve [F (2.79) = 142.465; p <0.001]; set [F (2.79) = 214.755; p <0.001]; and reception [F (2.79) = 242.145; p <0.001]. The *post-hoc* Tukey test showed that all tertiles showed significant differences (p <0.001) for all technical skills (serve, reception and set), where high-level athletes presented higher values compared to moderate level ones which, in turn, presented higher values compared to low-level athletes. For further analysis, athletes on the 2nd tertile (moderate level) were excluded, as in other studies [13,14].

Table 1. Descriptive analysis of the technical skills test according to tertile.

	Low level (T1)		Moderate level (T2)		High level (T3)		
	N	Mean (sd)	N	Mean (sd)	N	Mean (sd)	p
Serve	25	7.12 (5.22)	29	19.97 (3.25)	26	27.15 (4.32)	<0.001
Reception	26	8.23 (4.97)	32	24.75 (4.68)	22	37.95 (4.39)	<0.001
Set	26	11.19 (6.57)	28	27.39 (3.26)	26	39.04 (4.10)	<0.001

The study was submitted to the Ethics Committee of the Federal University of Viçosa and approved under protocol number 431.678. A free and informed consent (ICF) was delivered to participants' parents, who signed the document authorizing their participation in the research.

Instruments

This study consisted of two tests: (a) volleyball technical skills test; (b) decision-making test in the game situation, and their order was balanced among subjects.

Volleyball technical skills test

The evaluation of technical skills was performed by the Volleyball Skills Test Battery[15]. The aim of this test was to evaluate the three basic volleyball actions: serve, reception (forearm pass), and set, and for this, official volleyballs (PENALTY® model 6.0) and adhesive tape were used to demarcate the volleyball court according to the measurements of each test described in figure 1. In all tests, subjects performed a total of 10 attempts, and, previously, two attempts to adapt to each of them. In attempts where the subject violated the official rules of the game (FIVB 2014 - e.g. catch the ball, double contact, step on the line at the moment of serve) or did not perform the action according to the rules established in each test, participant obtained zero points. In addition, balls that hit the line had as evaluation criteria the highest scoring zone (e.g., if the ball landed on the line between scoring zones 1 and 2, the attempt was considered valid and worth 2 points). The test results were recorded by a researcher previously trained for instrument application as recommended in literature[15,16].

In the serve test, subjects perform the serve underhand or overhand from the service zone toward the opposite court, which was demarcated by lines that define the target areas, with values between two and four points (Figure 1a). In the reception test, the evaluator throws the ball to touch the attack line from one side of the court so that the subject, on the other side of the net, receives the ball, and wrong throws can be repeated. The subject performs five attempts at position 1 and five attempts at position 5, and should receive the ball in forearm pass so that it passes over a string tied to two vertical posts with height of 2.44 m and falls within demarcations performed on the volleyball attack line (Figure 1b). In the set test, the subject is positioned in the area demarcated by a square in the attack zone. The ball is thrown to the subject by the evaluator, which is positioned in the middle of the court and must be setted, pass over a string tied to two vertical posts of 3m high and fall within the target area (Figure 1c).

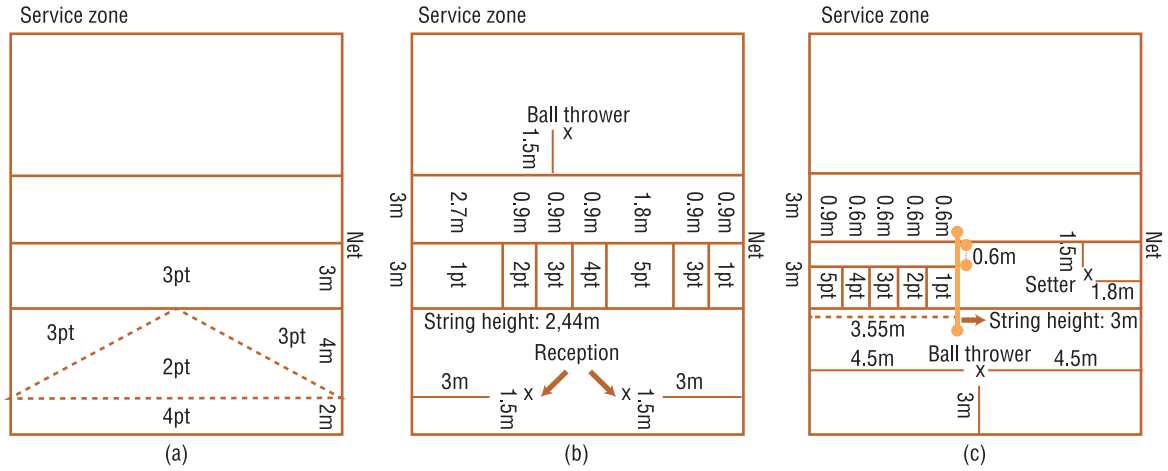

Figure 1. Diagram of the technical skill test regarding (a) serve, (b) reception and (c) set.

Decision making Test

To evaluate decision-making in real game situations, the subjects played a volleyball set according to the official rules of the game (FIVB, 2014) but in the 4x4 format with mandatory rotation of players. The test was recorded with a SONY ® camera, model HDR-CX380. The analysis of games and the categorization of actions were based on the Game Performance Assessment Instrument - GPAI[17]. As this study was conducted with volleyball, the decision-making components proposed by Mesquita[18] were adopted, which correspond to serve, reception and set actions (Table 2).

Table 2. Critical decision-making components in the volleyball game from 2x2 to 6x6[18]

Decision-making	Critical components
Serve	Puts the ball in the vulnerable space (empty space; less skilled player, etc.)
Reception	Passes the ball to player who makes the 2nd touch Puts the ball in the vulnerable space in the opponent's court
Set	Passes the ball to player who makes the 3rd touch Puts the ball in the vulnerable space in the opponent's court

The decision-making index (DMI) for each technical skill was calculated according to formula below[17], with modifications suggested by Memmert and Harvey[19]. The classification of action as appropriate or inappropriate was carried out by two independent experts and based on the critical components of each action, as described in the previous table.

$$DMI = \frac{(a_a+10)}{(a_a+10)+(a_i+10)}$$

DMI = Decision Making Index
a_a = appropriate actions
a_i = inappropriate actions

Procedures

Initially, the coaches of each team were asked to divide athletes into groups of four people of the same sex in order to establish yield homogeneity among teams. Athletes were informed of the research objectives and that the game would take place according to the official rules of the game, in

the 4x4 format, but would be played only one set of 25 points. Tests were performed once with each subject in schedule provided by the volleyball school and applied by individuals previously trained and qualified for the implementation of instruments.

Statistical analysis

Data analysis was descriptively performed (mean and standard deviation) and by inference procedures in the SPSS program version 20. Data normality was verified by the Kolmogorov-Smirnov test. In order to separate the sample subjects per group according to the skill level in serve, reception and set actions, the one-way ANOVA with *post hoc* Tukey was used to find possible differences. For comparison between groups of different skill levels, the t test for independent samples was used, adopting significance level of $p \leq 0.05$. The effect size was calculated using the Cohen's d test.

In order to test the reliability of observations in the decision making test, the percentage of intra-observer and inter-observer agreements was verified through the intraclass correlation coefficient (ICC), and the ICC value for all GPAI parameters (DMI-Serve = 0.80; DMI-reception = 0.89; DMI- set = 0.92) were considered satisfactory according to literature[20].

RESULTS

In the descriptive analysis of results, can be seen through table 3 that subjects, of higher technical level (T3) also showed the highest decision-making index values in all actions analyzed (serve, reception and set).

Table 3. Descriptive and comparative analysis of the decision-making test by tertile.

	Low level (T1)	High level (T3)		
	Mean (sd)	Mean (sd)	p	Cohens d
DMI-S	0.36 (0.21)	0.45 (0.05)	0.030	0.60
DMI -R	0.34 (0.24)	0.47 (0.19)	0.072	0.60
DMI -Se	0.29 (0.25)	0.53 (0.06)	<0.001	1.32

DMI-S - decision-making index in serve / DMI-R - decision-making index in reception / DMI-Se - decision-making index in set

In the decision-making test, significant difference in serve [DMI -S - t (49) = -2.23, p <0.05; d = .60] and set actions [DMI -Se - t (50) = -4.57, p <0.001; d = 1.32] between high technical level (T3) and low technical level groups (T1), with the latter obtaining the lowest performance in both indexes. The effect size was intermediate for serve and high for set actions.

In the decision-making index for reception, no significant differences (DMI -Se - t (46) = -1.84, p = .072, d = .60) were found among groups.

DISCUSSION

This study aimed to verify the influence of technical skill level on the decision making of novice volleyball players in serve, reception and set actions.

Based on the score of the technical skills test, the subjects were divided into three groups: low technical skill level (T1), moderate technical skill level (T2) and high technical skill level (T3), and only extreme groups (T1 and T3) were used in the analyses. The results showed that there are significant differences between groups of low and high technical skill level in relation to decision making in serve and set actions.

In the serve and set actions, individuals of higher technical skill level (T3) showed better decision making performed in real game situations when compared to individuals of lower technical skill level (T1). This result corroborates the findings of Bruce et al.[9], who investigated the pass action in netball and also found differences in favor of more skilled players who achieved better decision-making performance with concomitant correct execution of the action in real game situation. In the case of volleyball, the influence of technical skill on the decision-making is reinforced by modality features[21], such as the fact that the rule does not allow the retention of the ball and the ball to touch the ground, requires the correct execution of technical skills and allows a limited number of contacts with the ball.

Another explanation that supports the results found for serve and set actions concerns the tendency of young players, as those of lower technical skill level (T1) of this study, to learn motor skills by the trial and error method, which is characterized by the hypothesis test. In this method, the learner makes judgments of how to perform the task and in the best way and intuitively evaluates them according to the result. These processes tend to be magnified by additional instructions verbally expressed, most often by well-intentioned coaches or teachers, which leads to conscious and verbalized formation of small structures of knowledge. These structures are handled in a temporary space of information processing, commonly called working memory, which gives support for the motor action[22]. As the working memory is occupied with physical information such as the positioning of hands during touch in the set action, the subject cannot process other important information of the game, such as the position of the opponent's blocking and defense. It can negatively influence the decision making, which often ends up not being the most appropriate to the situation. In the case of more skilled players (T3), it is believed that the movement is already automated, not requiring the use of working memory during execution of the motor action, improving the decision-making process.

In the case of the reception action, the technical deficit of less skilled players does not influence their decision making significantly, since no differences were found among groups. One factor that may have contributed to this result is the fact that the complexity of the decision-making process in reception action is lower when compared to the serve and set actions, given the number of appropriate options in each. According to the analysis criteria, the reception action was considered appropriate when the ball was directed to the setter (player who performs the 2nd touch), which most often was player in position 3, or the ball was directly passed to the opposite court in the empty space. In the serve action, the player in the

present study had several options of vulnerable areas to serve, considering the game in the 4x4 format in court with official measures. Similarly, in the set action, the athlete could choose among three different attackers or pass the ball to the opposite court in the empty space. Thus, the serve and set actions showed a higher possible and appropriate amount of decision-making, which increases its complexity level[23].

A limitation of this study is the fact that it was carried out only one set of 25 points, and the game duration was not the same for all individuals, which can influence the number of individual actions performed. However the number of individual actions are relativized by the formula used in calculation of the decision-making index. In addition, the sample size can also be considered a limitation, given the small number of subjects in each technical skill group. The fact that the results of the Skills Test Battery have been measured by only one researcher is also a limiting factor, although researches had been previously trained for the use of the instrument.

CONCLUSIONS

Considering the characteristics of subjects of the present sample (e.g., adolescents and beginners), the results suggest that there is effect of the technical skill level on decision making in serve and set actions of volleyball, in which less skilled players had worse performance in the decision-making test when compared to more skilled ones. Thus, coaches should not restrict the evaluation of the athlete's tactical knowledge to only what he can perform in game situations, as it may be that his decision making is limited by his technical skill level. So it is important to use other resources (e.g., videos) that do not require motor execution of the action. At the same time, the execution of the necessary motor skills to solve any tactical problem imposed on the athlete by the game should be trained in a situational way.

Future studies should investigate the influence of the technical skill on the decision making in volleyball in more ecological situations (e.g., a game in the 6x6 format), according to the official rules of the game, and different categories and including high-level athletes. Moreover, additional procedures of observation reliability of the technical test battery data should be adopted, such as recording tests and subsequent analysis by independent experts, as was done in the decision-making test. It is noteworthy that studies on this topic should be carried out in real game situations, so that the correct execution of motor skills is a crucial factor for good performance in the test.

REFERENCES

1. Van der Kamp J, Rivas F, Van Doorn H, Savelsbergh G. Ventral and dorsal system contributions to visual anticipation in fast ball sports. Int J Sport Psychol 2008;39(2):100-30.
2. Raab M, Masters RSW, Maxwell JP. Improving the 'how' and 'what' decisions of elite table tennis players. Hum Movement Sci 2005;24(3):326-44.

3. Farrow D, Baker J, MacMahon C. Developing sports expertise: Researchers and coaches put theory into practice. 2nd ed. New York: Routledge; 2013.
4. Werner K, Raab M. Moving to Solution Effects of Movement Priming on Problem Solving. Exp Psychol 2013;60(6):403-9.
5. Topolinski S, Reber R. Gaining Insight Into the "Aha" Experience. Curr Dir Psychol Sci 2010;19(6):402-5.
6. Dicks M, Davids K, Button C. Representative task designs for the study of perception and action in sport. Int J Sport Psychol 2009;40(4):506-24.
7. Travassos B, Araujo D, Davids K, O'Hara K, Leitao J, Cortinhas A. Expertise effects on decision-making in sport are constrained by requisite response behaviours - A meta-analysis. Psychol Sport Exerc 2013;14(2):211-9.
8. Mann DL, Abernethy B, Farrow D. Visual information underpinning skilled anticipation: The effect of blur on a coupled and uncoupled in situ anticipatory response. Atten Percept Psycho 2010;72(5):1317-26.
9. Bruce L, Farrow D, Raynor A, Mann D. But I can't pass that far! The influence of motor skill on decision making. Psychol Sport Exerc 2012;13(2):152-61.
10. Johnson JG. Embodied cognition of movement decisions: a computational modeling approach. Prog Brain Res 2009;174:137-50.
11. Gréhaigne J-F, Richard J-F, Griffin L. Teaching and learning team sports and games. New York: Routledge; 2005.
12. Ericsson KA, Krampe RT, Teschromer C. The Role of Deliberate Practice in the Acquisition of Expert Performance. Psychol Rev 1993;100(3):363-406.
13. Gonzaga AD, Albuquerque MR, Malloy-Diniz LF, Greco PJ, da Costa IT. Affective Decision-Making and Tactical Behavior of Under-15 Soccer Players. Plos One 2014;9(6):1-6.
14. Lage GM, Malloy-Diniz LF, Neves FS, de Moraes PHP, Correa H. A kinematic analysis of the association between impulsivity and manual aiming control. Hum Movement Sci 2012;31(4):811-23.
15. Bartlett J, Smith L, Davis K, Peel J. Development of a Valid Volleyball Skills Test Battery. J Phys Educ Recreat Dance 1991;62(2):20-1.
16. Junior LAM, Deprá PP. Validação de lista para análise qualitativa da recepção no voleibol. Motriz 2010;16(3):571-9.
17. Oslin JL, Mitchell SA, Griffin LL. The Game Performance Assessment Instrument (GPAI): Development and preliminary validation. J Teach Phys Educ 1998;17(2):231-43.
18. Mesquita I. Ensinar bem para aprender melhor o jogo de voleibol. In: Tani G, Bento JO, Petersen RDS, editors. Pedagogia do desporto. Rio de Janeiro: Guanabara Koogan; 2006. p. 327-43.
19. Memmert D, Harvey S. The game performance assessment instrument (GPAI): some concerns and solutions for further development. J Teach Phys Educ 2008;27(2):220-40.
20. Reiman MP, Manske RC. Functional testing in human performance. Champaign: Human Kinetics; 2009.
21. Lima COV, Martins-Costa HC, Greco PJ. Relação entre o processo de ensino-aprendizagem-treinamento e o desenvolvimento do conhecimento tático no voleibol. Rev Bras Educ Fís Esporte 2011;25(2):251-61.
22. Masters RSW. Theoretical aspects of implicit learning in sport. Int J Sport Psychol 2000;31(4):530-41.
23. Raab M. Implicit and explicit learning of decision making in sports is effected by complexity of situation. Int J Sport Psychol 2003;34(4):273-88.

CORRESPONDING AUTHOR

Mariana Calábria Lopes
Endereço: Universidade Federal de Viçosa. Departamento de Educação Física. Av. Peter Henry Rolfs s.n., Campus Universitário
CEP:36570-900, Viçosa, MG. Brasil.
Email: lopesm@gmail.com