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ORIGINAL

KNOWLEDGE OF OPPOSITION ATTACKING TENDENCIES ON VOLLEYBALL BLOCKING

CONOCIMIENTO DE LAS TENDENCIAS DE ATAQUES RIVALES EN EL BLOQUEO DE VOLEIBOL

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ABSTRACT

The aim of the study was to investigate the effects of providing probabilistic information, obtained from video-performance analytics on passing direction tendencies in opposing volleyball setters, on blocking performance in a high skilled female volleyballer. Data on reaction times, decision-making and quality of movement execution of the skilled blocker were analyzed during 1117 blocking actions in 18 competitive matches, before and after receiving information from the passing tendencies of opposition setters. Results revealed that the blocker reacted significantly earlier in those matches when she received information about opposition pass direction tendencies. No effects of contextual information were found for the blocker´s decisions and quality of movement execution. These results reinforced the use of probabilistic information as a competitive strategy for initiating an early preparatory response to the blocking action in high-skill levels of volleyball.

KEY WORDS: Probability, information, performance analysis, motor behavior, blocking action, high level, volleyball.

RESUMEN

El objetivo del estudio fue investigar los efectos de proporcionar información probabilística, obtenida del análisis de rendimiento de las tendencias de pase de las colocadoras oponentes, sobre el rendimiento en el bloqueo de una jugadora profesional de voleibol. Se analizaron sus tiempos de reacción, toma de decisiones y calidad de ejecución, antes y después de recibir esa información contextual de los ataques rivales. Los resultados revelaron que la bloqueadora reaccionó significativamente más pronto en aquellos partidos en los que había recibido información sobre las tendencias de pase de las colocadoras oponentes. En cambio, esta información contextual no tuvo una influencia sobre las decisiones de la bloqueadora ni en la calidad de ejecución de sus movimientos. Estos resultados refuerzan el uso de información probabilística como una estrategia competitiva para iniciar antes una respuesta preparatoria a la acción del bloqueo en el alto nivel de voleibol.

PALABRAS CLAVE: Probabilidad, información, análisis del rendimiento, comportamiento motor, alta destreza, voleibol.

1 INTRODUCTION

The ability to anticipate actions is crucial in sports with high spatiotemporal constraints on performance. The use of contextual information is a perceptual skill that, together with the ability to pick up advance information from an opponent's movements and recognition of the play patterns, allows athletes to anticipate opponent actions and make accurate, contextualized decisions (Williams & Ward, 2007). Specifically, the integration of kinematic and contextual information, for example from opposition movements and game events, is critical for facilitating skilled anticipation (Murphy et al., 2016; Runswick et al., 2018b). However, there is a relatively limited amount of evidence in the literature about the contribution of such contextual information to anticipatory behavior, compared to other perceptual skills (Farrow & Reid, 2012; Murphy et al., 2018). For example, Hernández et al. (2011) found that expert volleyball players improved their response times after a training with an automated system including video-projection of advanced visual cues of opponents' movements. Sáez-Gallego et al. (2018) determined that the perceptual training applied to youth volleyball players improved their decision-making process, since they reduced their reaction times while maintaining their percentage of correct responses. Castro et al. (2019) also concluded that visual fixation times of volleyball coaches were significantly longer than those performed by young players when perceived filmed attacking sequences, although these differences had no influence on their decision accuracy. In contrast, there are no applied interventions that have tested the contribution of this contextual information in competitive sports contexts.

Contextual information in sport is related to the advanced visual cues that emerge at the beginning of play sequences (Abernethy et al., 2001). These visual cues could include the performance patterns and tendencies, field positions, and strengths and weaknesses of specific opponents (Buckolz et al., 1988). The use of this contextual information is based on the ability to generate prior expectations about action options (e.g., opposition movements emerging in a particular sports performance context; see Crognier & Féry, 2005; Roca et al., 2013), and especially in defensive situations (Triolet et al., 2013).

This type of perceptual skill has been referred to with different terms in the scientific literature. To exemplify: *prior knowledge of probable upcoming events* (Buckolz et al., 1988), *situational information* (Navia et al., 2013), *situational probabilities* (Crognier & Féry, 2005; Farrow & Reid, 2012; Roca et al., 2013; Ward & Williams, 2003), or *situational probability information* (Abernethy et al., 2001; Milazzo et al., 2016). In the current study, probabilistic information was referred as the knowledge of an opponent´s action tendencies and preferences, and was classified as *non-situation specific* contextual information because it is a stable source of information (i.e., it is not changeable and uniquely dependent on the context of a particular sport event; see Runswick et al., 2018a).

Most studies investigating the effect of contextual performance information in sport have been conducted in controlled laboratory settings, requiring participants to respond to video-projected sequences, often in a verbal manner (Mann et al., 2014; Loffing & Hagemann, 2014; Ward & Williams, 2003) or using non-specific movements (Farrow & Reid, 2012). The results of these studies concluded, for example that: i) expert badminton players predicted better the direction and the depth of the strokes than novice players (Abernethy et al., 2001), ii) goalkeepers initiated early responses in a penalty task compared to footballers (Peiyong & Inomata, 2012), and iii) high tennis players made accurate judgments about the ball direction using the opponent position on-court than low skill players (Loffing & Hagemann, 2014).

In real scenarios, the results revealed that expert tennis players anticipated better the direction of the opponent’s passing-shots when they had tactical initiative in tennis using an occlusion glasses technique (Crognier & Féry, 2005). Navia et al. (2013) found that goalkeepers tended to dive earlier and more accurately to the goal side when participants perceived the two high-probability conditions (i.e., 80% to the right or left side of the goal). Similarly, Milazzo et al. (2016) argued that expert karate athletes enhanced decision time and decision accuracy defending opponents´ attacks because they used probability information compared to other less skilled counterparts (i.e., they perceived the occurrence of the attack pattern after five trials, using this information to improve later decisions against karate opponents). Collectively, research conducted in laboratory settings as well in actual competitive sport performance environments has concluded that expert athletes use contextual performance information more effectively than other low-skilled groups because expert performers use their knowledge and expertise to anticipate events and actions more effectively, frequently and with greater accuracy.

However, information about opponents' action tendencies and preferences could impair also athletes´ performance when this advance information is not related to the outcomes of an opponent's actions, nor consistent with prior expectations. For example, Mann et al. (2014) found that a skilled group of handball goalkeepers enhanced their anticipation performance to predict the direction of penalty throws when their preferences for a particular direction was congruent during and after a training programme. In contrast, anticipation performance decreased when penalty throw directions were not congruent with preferred directional tendencies of opponents observed during the training. This detrimental effect of reliance on contextual information has also been previously reported in a study of novice baseball batters when they perceived information from a pitch being incongruent with preceding outcomes (i.e., the batters performed a greater number of errors in a simulated fast ball pitch when they had previously faced three slow balls; see Gray, 2002).

In volleyball, Loffing et al. (2015) observed that participants moved earlier and achieved a higher level of response accuracy in congruent trials with a pattern of previous attacking outcomes, compared to incongruent volleyball attacks. Noël et al. (2016) showed that the positions of the receiving players influenced the decisions of participants to what court area to perform in beach volleyball. Paulo et al. (2016) found that the receiver´s positioning, together with their movements of reception, were the most relevant factors influencing the selection of the pass and efficacy for the serve-reception.

Most studies addressing probabilistic information about action preferences in sport have used a participant confidence approach to estimate the certainty of judgments (Mann et al., 2014). Therefore, there is a need to understand the impact on athlete competitive performance of providing augmented probabilistic information on opposition patterns and performance tendencies (Cañal-Bruland & Mann, 2015). This type of investigation is mandatory to clarify whether there is a positive or negative effect of being exposed to opponents´ action tendencies and preferences on an individual athlete's competitive performance. In this line, the specific objective of this study is to carry out an intervention based on the knowledge of the probability of passes made by the setters of the opponent teams, in different competitive matches and, to determine what influence would have on reaction times, decision-making and the quality of movement execution of a high skilled volleyball player, during specific blocking actions.

Based on previous evidence, we expected that the main designated blocker of a team would achieve better performance outcomes in those matches receiving specific information about the opposition setter's passing tendencies, compared to other matches in which no supplementary contextual information was provided by performance analysis. Specifically, we hypothesized that probabilistic information would reveal as a key informational constraint that facilitated the regulation of planned movements (Chow et al., 2009; Newell & Ranganathan, 2009), creating an initial expectation about the passing directions of opponent setters and finally, helping the blocker to react earlier, make adapted decisions to the play and, perform blocking actions with higher quality of movement execution.

2 METHODS

2.1 PARTICIPANTS

The sample of participants was formed by one athlete being member of a professional female volleyball team competing, at the beginning of the investigation, in the Female Super-League 2 (Group A - Second National Division in female volleyball in Spain). This team also played during the last four previous sport seasons in the First Spanish National Division in female volleyball (Female Super-League). Analysis of effects of providing knowledge about the passing tendencies of opposition setters was focused on the main blocker of the team because the main role of this player was to perform defensive blocking actions against attacking opponents. According to data provided by the assistant coach, she performed approximately 95% of the blocking actions of the team. Specifically, this blocker was 24 years, playing competitive volleyball for the past 13 years (e.g., she had competed in the first teams of development squads from U-10 to U-18 yrs of age). She also played as blocker in different volleyball teams for 10 yrs, playing in the role of middle blocker for the past three years for her current professional, female volleyball team.

We decided to investigate the blocking actions of the middle blocker because these actions are crucial for winning teams in volleyball (Lobietti, 2009). For example, participation in the blocking action was a predictive variable related to the accuracy of the defense complex in both female and male U-16 yr olds volleyball competitive performance categories (González-Silva et al., 2018). To achieve our aim, we analysed 1117 blocking actions made by the participant, extracted from 18 competitive matches against other teams playing in the Female Super-League 2 competition. These data corresponded to nine matches in each of the first and second rounds of the championship. Specifically, the blocker received detailed information about the attacking patterns and tendencies of five teams during her matches played in the first round of the championship (n = 317). Later, her blocking performance was analyzed against these same opponents during the second round of the competition (n = 315). Also, the matches of other four competing teams were filmed during the first round of the championship (n = 250). However, this information was not provided to the blocker, but was used again in comparisons of her performance against the same four opposing teams in the second round of competition (n = 235).

Before commencing the investigation, the blocker consented and accepted her voluntary participation in the study, according to the ethical guidelines of the University and Declaration of Helsinki. The participant received background information about the task, but were naïve to the hypothesis of investigation. The Club authorized the recording of those competition matches in which a subsequent analysis of the passing tendencies of opponent teams was to be carried out. Information related to the blocker, team, and opponent teams was kept anonymous in order to preserve confidential identities of participants.

2.2 APPARATUS

A Xiaomi Redmi Note 7 smartphone, with 1080p HD resolution and frequency rate of 120 Hz, was used to record the passing patterns and tendencies of the opposition setters. This portable device was placed at the back of the volleyball court, 5 m away from the players, and 2.5 m above the floor to provide a full view of the playing passages and sequences (see Figure 1).

Figure 1. Viewing perspective from the mobile device used to record the blocking actions in the volleyball court

The software KINOVEA 0.8.15. was used to analyze later, and in further detail, the motor actions and decision-making of the blocker.

2.3 DESIGN

The independent variable that was manipulated in our design was the *Knowledge of the probabilistic information* that the blocker had about the attacking tendencies and passing patterns of setters in the opposing teams (*Level 1*: Matches with the provision of probabilistic information or WITH_PI; *Level 2*: Matches without probabilistic information or NOT_PI). An example of probabilistic information provided by the auxiliary coach to the blocker was: "For this opponent team, the setter´s attacking preferences when the rotation efficiency was good was: 51.72% (zone 4); 17.24% (zone 31); 17.24% (zone 2); 10.34% (zone 52); and 3.44% (zone 10). However, when the rotation efficiency was bad, the setter´s passing tendencies was 58.33% (zone 4); 12.55% (zone 10); 16.66% (zone 2); and 4.16% (zone 52)". The specific data recorded of attacking tendencies was different for each of five opponent teams. The blocker had not previously received such specific information about the passing tendencies of opposition setters, just generic information about opponent teams and counterparts available on the website of the Royal Spanish Volleyball Federation.

The blocker's performance was investigated in relation to the opposition setter´s passing performance. Specifically, data on the reaction time (RT), decision making (DM), and quality of movement execution (QE) was analyzed during her defensive blocking actions performed in response to the passes executed by the setters of the opponent teams. The RT was defined as the time elapsed (in ms) since that the opponent setter performed the pass until the blocker initiated her movement in response to that hitting. Specifically, the *frame-by-frame* technique was employed to calculate the RT for each trial; identifying the first photogram in which the opponent contacted the ball with her hands to pass it to other teammate, and the first photogram in which the blocker moved her foot in direction to that setter´s passing ball direction. This procedure of measurement by initiating a first quick movement to the target has been previously used, for example, to anticipate the outcome of the ball in tennis (Shim et al., 2005) or to hit the attacker´s target in fencing (Nakayama et al., 2014).

The DM process concerned a choice about how to perform the task, adapting movements to the contextual demands in order to achieve particular task outcomes (Hodges et al., 2007). In the current investigation, the DM was measured through the *Game Performance Assessment Instrument*, assigning a value of 1 for those decisions considered appropriate, and a value of 0 for those actions considered inappropriate. The use of this instrument for the analysis of DM has previously been validated by Oslin et al. (1998) for investigating performance in volleyball and other team sports. Specifically, if the blocker initiated a movement of her feet in the direction of an opposition setter's pass, then, this DM was coded as a 1. If the blocker remained still or if she moved in a different direction to the setter's completed pass direction, then, the DM was coded with 0. For a better interpretation of this variable, the final value of this analysis of DM performance was normalized to the number of actual decisions made in blocking actions, expressed as a percentage of this value (i.e., if the blocker completed 7 of 10 DMs correctly and being scored as a 1, then, the DM accuracy was 70%).

The quality of movement execution (QE) during the blocking action was analyzed in relation to the outcomes of opposition's attacking performance (i.e., successful completion of the attack or not). Specifically, the observation system developed by the International Volleyball Federation, consisting of a scale of values from 0 to 4, was used to investigate this variable. In this study, the QE was codified with 0 = when the blocker´s team lost the point after this blocking action; 1 = the blocker's team won the ball back but with little opportunity to continuing play, or the opposition retrieved the ball with high probabilities to counter-attack; 2 = the blocker's team won the ball back, but without counterattacking immediately, or they provided some difficulties for the opposition to maintain possession of the ball; 3 = the blocker's team developed many counterattacking opportunities, or creating many difficulties for the opposition to maintain possession of the ball ; and 4 =the blocker's team won the point after the blocking action.

2.4 PROCEDURE

The probabilistic information about opponent teams´ attacking tendencies was recorded during the first round of the competition. Specifically, a total of nine of 11 matches of the initial round of competition were recorded to identify passing tendencies of opponent teams. This information was later communicated by the auxiliary coach to the blocker during the second round of the competition, before matches against those specific teams analyzed previously. The research team and the auxiliary coach decided together that the blocker would receive augmented contextual information in those matches not performing an accuracy level of 100% appropriate decisions (i.e., five matches). In the other four matches, all her decisions were considered appropriate, and then, she was not given this contextual performance information to improve her blocking performance.

A research member codified all blocking actions of the participant. He had several years of visual experience observing training sessions and matches in volleyball. He underwent training in encoding the information from blocking actions together with an expert volleyball coach to ensure reliability and quality of data encoding from observations of the blocker´s actions. This training period lasted three sessions, including the viewing of the opponent setters´ actions against different teams from the same competition. To calculate consistency values between the research member and the expert coach, they observed more than 10% of the total number of blocking actions performed by the blocker of this study (Tabachnick & Fidell, 2013). The interobserver an intraobserver agreement values were above the .75 reference value for all sessions of the training (Fleiss et al., 2003). To exemplify, this agreement rate achieved an interobserver Cohen Kappa value higher than .81 in the third training session, which was the minimum value considered as almost perfect (Landis & Koch, 1977). To address the intraobserver reliability, a final test was performed one week after the third training session, revealing Cohen Kappa values higher than .81.

2.5 DATA ANALYSIS

Firstly, a Kolmogorov-Smirnov test was carried out to check the normal distribution of the dependent variables. Results revealed that the RT values displayed a normalized distribution, in contrast to the data of DM and QE, which displayed a non-parametric distribution. Next, a MANOVA was used to test whether there were any differences in RT: i) between WITH_PI and NOT_PI matches in the final round of competition (between-groups factor), and ii) for each group of WITH_PI and NOT_PI matches, compared between the initial vs final round of the competition (within-groups factor). This analysis also provided the proportion of variance explained in RT as result of the *Knowledge of the probabilistic information* (n_p^2), and the probability of rejecting the null hypothesis when it was really false (1 – β).

For the analysis of the DM and QE data, Mann-Whitney and Wilcoxon tests were performed to analyse, between- and within- group differences respectively. The effect sizes (*ES*) were calculated to provide a better interpretation of the results for those analyses with significant differences in the between- and within-groups factor. The value of the *Z* distribution, obtained from performing these non-parametric tests, was used to estimate the magnitude of *ES* for DM and QE variables. Specifically, three categories of Cohen (1988) were used to interpret *ES* (small: d = .20, medium: d = .50, large: d = .80). The confidence intervals for effect sizes (*CI*) were calculated with the formula: 95% *CI* = *ES* - 1.96*se* to *ES* + 1.96*se* (Cumming, 2012) to provide a practical value of the study in real-world terms (Thompson, 2002). Tthe statistical power was calculated with the G*Power software 3.1.9.2 (Faul et al., 2007) to test whether the statistically significant findings reflected true effects. A value of ≥ 80% power was set for analyses because it is an acceptable level to correctly reject the null hypothesis (Cohen, 1988). An Alpha level of p < .05 was required for all analyses. The statistical analysis was made with the statistical package 25.0 SSPS (© 2017 SSPS Inc.).

3. RESULTS

The descriptive statistical analysis showed that the blocker´s performance was characterized by high percentages of DM, both before and after receiving augmented feedback about the opposition setters´ passing tendencies (see Table 1). This analysis also showed low values for QE. The values of RT were lower in those WITH_IP matches compared to the NOT_IP ones, during the initial and final rounds of competition.

Table 1. Means and standard deviations (M and SD) for those variables included in the blocker´s performance, at the initial and final round of competition.

	RT[1]		DM[2]		QE[3]	
	Initial	Final	Initial	Final	Initial	Final
WITH_IP matches	92.66 ms (1.75)	71.88 ms (8.78)	91.06% (5.73)	95.05% (17.35)	1.80 (.27)	1.94 (.33)
NOT_IP matches	118.52 ms (3.53)	123.84 ms (7.06)	100%	100%	1.83 (.31)	1.80 (.43)

Legend: [1]Reaction time, [2]Decision making, [3]Quality of execution

The MANOVA revealed differences in the blocker´s RT between WITH_IP and NOT_IP matches ($F(2,7) = 18.93$; $p < .01$). Specifically, pairwise comparisons showed that RT values were significantly lower in WITH_IP matches, compared to NOT_IP ones, in the final round of competition. The mean differences were 51.96 ms ($p < .001$; $n_p^2 = .93$; $\beta = 1$). For those WITH_IP matches, the blocker also displayed lower RT values in the final round of competition, compared to the initial round (mean differences of 20.78 ms; $p < .01$; $n_p^2 = .90$; $\beta = .99$). No significant differences were found between the blocker´s RT values during the initial vs final rounds of competition for the NOT_IP matches ($p < .38$; $n_p^2 = .26$; $\beta = .11$). For DM, the comparison between the WITH_IP and NOT_IP matches in the final round of competition showed a significant mean difference of 4.95% ($p < .05$; $d´ = .38$; *CI*: .21 to .55; $\beta = .98$). However, the WITH_IP matches did not show a significant improvement in the percentage of appropriate decisions, in the final round of competition compared to the initial round (intra-group factor), as this improvement was only 4% ($Z = 1.48$; $p = .13$). For QE, no significant differences were found between the initial and final rounds of the competition (intra-group factor), in the WITH_IP matches ($Z = .67$; $p = .50$). There were no also differences between WITH_IP matches and NOT_IP matches (between-group factor), in the final round of the competition ($Z = .73$; $p = .55$).

4 DISCUSSION

The aim of the study was to address the effects of providing probabilistic information about the opposition teams´ passing preferences in attack on the blocking performance of a high skilled volleyball player. Specifically, the impact of this contextual performance information was evaluated on the participant's reaction times, decision making, and quality of movement execution. The blocker demonstrated her perceptual expertise by displaying a high-performance level for reactions and decision-making behaviours, before and after receiving probabilistic information about the opposition setters´ passing preferences. Previous research has concluded that quick reactions are very important for performance volleyball (e.g., Nuri et al., 2013; Mroczek et al., 2013).

Our data imply that the participant's great motor experience and knowledge of volleyball, together with her extensive perception of the specific patterns of play, helped the blocker to anticipate the setters' actions and make correct decisions (Ericsson & Kintsch, 1995), triggering automated action processes between 75-100 ms post-stimulus (Fei-Fei et al., 2005). In this line, in her blocking performance she achieved reaction times lower than 180 ms in all matches analyzed. These data could be considered as emanating from anticipatory responses, according to Hick´s law for choice reaction times (Hick, 1952). This high level of anticipatory performance could be underpinned by a greater accumulation of visuomotor experiences in sport (Brenton & Muller, 2018). For example, Cañal-Bruland et al. (2011) found that high-skill volleyball players outperformed the outcome of opposition attacks in beach volleyball, compared to high-skill volleyball referees, because they previously had more specific visual and motor experiences in that sport.

In this study, we have provided evidence that aspects of a lead blocker´s anticipatory performance could be significantly improved by the provision of augmented knowledge of the opposition setters´ attacking tendencies, provided by performance analytics. The blocker displayed significantly improved reaction times in those matches where she had prior information on opposition setters´ passing directions compared to matches where she did not receive this probabilistic information. The values of n_p^2 and β were both higher than .9, and then, there was a higher probability of 90% that the *Knowledge of the probabilistic information* caused changes in reaction capacity, and that these modifications in reactions reflected a true effect respectively.

Our data are aligned with results of previous studies which have reported this effect of using knowledge of opposition action preferences for the improvement of movement times in athletes (Loffing et al., 2015; Mann et al., 2014; Milazzo et al., 2016; Navia et al., 2013). We reasoned that the knowledge of the opponent teams´ attacking preferences could be considered as a prior cue of attacking sequences in volleyball, which primed the subsequent defensive actions of the blocker. Therefore, the augmented verbal information provided by the auxiliary coach, prior to performance enhanced the blocker´ anticipatory performance as a key informational constraint that facilitated the regulation of planned movements (Chow et al., 2009; Newell & Ranganathan, 2009).

The expert blocker achieved a high level of decision-making performance, showing higher percentages of 90% appropriate decisions for all matches analyzed despite constraints in time, information, and cognitive capacities. Previously, Vila-Valdonado et al. (2014) found that high skilled volleyball players achieved a significantly higher percentage of response effectiveness in decision-making in relation to the zone to which the opponent setter passed the ball (81.40%), compared to amateur players (72.55%). In this study, the expert blocker displayed a 4% improvement in the rate of making successful decisions when an orientation to the setters´ passing directional tendencies was provided, although this increase was not statistically significant and not sufficient to prevent differences compared to those matches without contextual information due to the 100% rate of appropriate decisions. Nonetheless, we reasoned that the knowledge about setters´ passing tendencies acted as a valid cue positively correlated with expected outcomes, facilitating blocker´s adaptive behaviours in changing environments (e.g., to make allocate decisions in real matches; see Gigerenzer & Selten, 2001).

Finally, knowledge about the setters´ passing directions did not impact in the quality of execution of the expert blocker because no significant improvements were found in this variable between matches with vs without probabilistic information. We suggest that the opponent setters, similarly to the blocker, had a high-skill level playing volleyball and, therefore, performed the passes with great precision but also including deceptive information in movement (Güldenpenning et al., 2017). This intention of diving your opponent constrained the blocker´s performance, resulting in actions with low quality of execution.

Based on these results, we are confident in reporting that the contribution of the probabilistic information just influenced significantly blocker´s reaction capacity because this contextual performance information was related to the development of expectations about setters´ movements (i.e., predictions at an early stages of the setters´ unfolding actions) rather than with the biological motion cues included in the kinematic information (Roca et al., 2013).

Future investigations should increase the sample size of blockers studied to test whether the effect found, of probabilistic information on a skilled volleyball player´s reaction times, may be extended to other athletes of the same skill level. The replication of this study with a larger sample of participants could enhance the external validity of our observations to the population (i.e., generalizing results to all female skilled blockers), because they would be a representative sample of blockers at this high performance level. In similar vein, further studies could include analyses of contextual information applied to practicing of other specific actions in volleyball (e.g., service reception). It would be also interesting to address the impact of advance probabilistic information on the competitive performance of athletes at lower skill levels (e.g., intermediate or low skilled participants).

Other questions to elucidate in future studies could examine what type of contextual information would exert a greater influence on blocking performance in volleyball. For example, would situation-specific (e.g., the opponent positions, game score) or non situation-specific contextual information (e.g., the playing style, team´s past outcomes) be more influential (see Runswick et al., 2018a)?. Adressing these important questions may provide a stronger platform to enhance learning and training designs for acquiring specific volleyball actions through more prescriptive or discovering methodologies (e.g., the manipulation of task contraints coined by the non-linear pedagogy and the ecological approach; see Caldeira et al., 2019).

In later phases of investigation, the use of contextual information could be combined together with kinematic information to study, both the contribution of the contextual and kinematic information for the improvement of blocker´s reaction times, but also for the enhancement of her decisions and quality of movement execution. Previous studies have found the individual effect of introducing kinematic information of opponents´ movements in volleyball, improving response times (Hernández et al., 2011) or decision-making in blocking actions (Sáez-Gallego et al., 2018). Could then the interaction of both types of information: contextual and kinematic enhance the performance of high-skill level of volleyball players? For example, the blocker could use the contextual information of the orientation and spatial position of an opponent setter on the court, before she passed the ball, to anticipate the opponent's attack pattern (Takeyama et al., 2011). Also, she could display a proficient perceptual pattern related to higher percentages of success in blocking actions whether she made shorter fixations on the shoulder-elbow and head, but also a greater number of fixations on the ball-wrist (Vila-Maldonado et al., 2019).

5 CONCLUDING REMARKS

This research corroborates the novelty assumption that the knowledge of probabilistic information about setters´ action preferences, isolated from the kinematic information, caused a true effect in reaction capacity but not in decision-making and quality of execution of an expert female blocker playing in a professional volleyball team. Specifically, the blocker initiated early responses after receiving this contextual information but not influenced processes of decision-making and performing blocking actions during real matches.

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