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Situational Analysis and Tactical Decision-Making in Elite Handball Players

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Abstract: Situational analysis and decision-making represent key elements of elite sports performances, but few studies have investigated which player's skills related to these aspects are relevant in elite handballers. The aim of this study was to address differences among handballers belonging to two tiers in processing situational probabilities information related to offensive and defensive situations. A total of 38 handballers (male = 22, female = 16, age: 25.6 ± 6.5 years, first-tier = 11, second-tier = 27) saw videos about different offensive and defensive actions. According to the temporal occlusion paradigm, each handballer provided a response about the best action a selected player had to perform according to the game's context. The time, accuracy, and technical correctness of each player's response were assessed. MANOVA revealed moderate-to-high skills differences between first- and second-tier players. First-tier players provided higher scores in response time and accuracy; they also obtained higher technical correctness scores in the most complex situation. The members of the first tier seemed to mainly depend on the accuracy of responses, even if the technical correctness also resulted in a predictor in the most complex situation. Playing in the best tier seems to require the development of very good skills related to processing situational probability information; therefore, training these elements seems to be necessary for determining the differences among elite handballers.

Keywords: accuracy; technical correctness; temporal occlusion; video-based assessment; situational probability information

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1. Introduction

Handball is a team sport where time constraints and one's own and opponents' tactics are key elements of each performance; they have a significant impact on handball players' decision-making process and, as a consequence, are decisive in the match's result. Theories of ecological dynamics consider team sports as complex systems [1]. These sports are often defined as open skills and are characterized by the presence of a particularly unpredictable environment in which athletes need to react and adapt to a dynamic and constantly evolving environment [2]. They differ from closed-skills sports (such as archery), which are characterized, on the contrary, by a low dynamic and fairly predictable environment in which the athlete's self-control is essential for the success of the performance [2]. Continuous interaction between players and information from the environment (such as ball trajectory and goal positioning) affect stability (i.e., coordination between competitors), variability (i.e., loss of coordination), and the emergence of new states of organization within the dynamics of performance [3]. As a consequence, sports contexts are characterized by game situations with high levels of uncertainty and are developed under time pressure. Furthermore, open-skills sports are characterized by the repetition of actions that require athletes to have good levels of physical fitness and well-developed technical and tactical skills [4–6]. Tactical skills are strategic mental abilities engaging cognitive abilities to achieve an immediate purpose in game situations. Tactical tasks in sports (such as offensive/defensive gameplay) require gaze control, attention in the quick detection and interception of objects/individuals, and the ability to read and extract meaning from dynamic situations [7]. In this scenario, the ability to anticipate actions and make decisions are fundamental to promoting effective behavioral responses [8] (p. 87). Anticipation is the player's ability to use information from the environment to predict an opponent's action and respond appropriately [9,10]. Making decisions in dynamic contexts implies complex cognitive skills, such as triggering a chain of interdependent decisions that require a continuous redefinition of the observed situation. In this sense, the mental representation of sports situations seems to incorporate the flow of contextual information in its temporal continuity. Then, the athlete can be seen as a dynamic decision-maker who responds to the stimuli and constraints posed by the environment in a short time frame, choosing how and when to perform his or her action on the basis of the antecedent situations and possible consequences [8] (pp. 93–94). Therefore, studies about how situational probability information affects decision-making processes seem to be relevant to the extent of sports science knowledge on this topic.

1.1. The Use of Situational Probabilities Information

Previous studies have shown that the use of expectations or situational probability information facilitates anticipation and decision-making [11,12]. The use of situational probability information is the skill of using prior contextual information in order to assign probabilities to events likely to occur within a situation [12]. It has been suggested that experienced athletes can use their knowledge to dismiss many events considered highly improbable and consider other events based on their probability, thus reducing the uncertainty of what is likely to happen [13]. Previous research on the decision processes in situational analysis has shown that experts consider a smaller amount of information and focus on only a few elements to generate appropriate options [14]. Johnson and Raab's study analyzed the process of options generation in a sample of 80 handball players of different ages and performance levels [15]. Handball players were asked to view videos that presented realistic tactical situations. The videos were stopped when a certain player took possession of the ball, and the players had to name the first option that came to their mind; after that, they had to discuss further options appropriate to the situation and finally choose the best option. The results confirmed the use of the take-the-first heuristic strategy, which assumes that the first option generated is better than the others generated later. The study also showed that experts stop the option-generation process after generating a few options and choose the first or one of the first options generated. Heuristic strategies (such as the simple heuristic take-the-first) explain how individuals make many choices in a very short time. However, they did not provide insight into how the skills necessary for option evaluation, recognition of valid clues, or behavioral differences of individuals in the same situation are learned [8,16]. In this sense, specifically in handball, studies have mainly focused on memory processes, visual attention, perceptive ability, reactivity, or anticipation skills, highlighting that: (1) working memory and attention can facilitate the identification of relevant information; (2) anticipation and reaction time appear to be better for experienced players than for beginners [17]. Furthermore, from a comparison between elite and beginner handballers, it emerges that the elite players take longer to make a decision that is also more accurate. Hinz, Lehmann, and Musculus [18] describe this phenomenon as the speed–accuracy tradeoff [19], according to which spending more time making a decision can lead to higher success rates and fewer errors [18,20]. The same authors state that as time increases, the kinematic signals deriving from the opponents lengthen. In this sense, handball is outlined as a strategic sport, which is defined as "a sport that involves multiple teammates, often resulting in tactical formations during offensive and defensive series, and emphasizing the importance of allocating attention to both the projectile involved and the diverse array of participants" [21]. Therefore, within a handball action, it is possible to find game dynamics in which the continuous interaction with players and the environment impacts the variability of performance. For example, a breakthrough is characterized by the high frequency of dynamic kinematic information (e.g., through the attackers' deceptive move). In this situation, to make a decision, the defenders are conditioned by the attacker's postural changes, which lead to premature movement [22].

1.2. Methodological Approaches in Decision-Making Research

There are two approaches to studying decision-making processes [17]. The naturalistic approach addresses how a player analyzes a situation in a real context, examines collective capabilities such as coordination between actors, develops a strategic plan, and shares tactical awareness. The cognitive approach, on the other hand, studies the strategies for gathering information in the environment, the organization of the knowledge acquired by the player, and the memory processes involved [17]. These analyses are quantitative and are performed using implicit methods, explicit methods, or perceptual tasks. As recently expressed by Bonnet et al. (2020) [17], explicit methods use simple questions and verbalizations; implicit methods use recall and recognition tasks, in which subjects have to find the correct objects or locations; and perceptual tasks are based on the use of temporal occlusion. To the best of our knowledge, the last method allows for capturing differences among experts, primarily in the anticipation phase of a decision. The main advantage of this method is the ability to analyze the selection of information relevant to the decision making, although ecological validity is limited [14]. Considering the importance of the ecological validity of research and, at the same time, the frequent impossibility of observing phenomena directly in their natural condition, methods based on computer simulation have been classified as essential to examine this type of phenomenon [8] (pp. 91–93). In particular, temporal occlusion has been used to study the quality and the accuracy of decisions made by athletes and, likewise, to examine how these aspects are influenced by various covariates, such as age, the relative age effect, or competence, as well as acute factors such as fatigue [3]. Comparisons between experienced and non-experienced players have shown that the experts' superior skills allow them to make accurate decisions faster than their non-experienced counterparts [23–26]. The higher performance of expert athletes depends primarily on the internal mental representations and cognitive processes that mediate the interpretation of a stimulus and the selection of an appropriate response [3].

In summary, decision-making is the ability of players to choose functional actions from several possible actions that emerge from the environment to achieve a specific goal [3]. Therefore, it is an important factor for successful performance in team sports [27]. However, few studies have attempted to analyze the knowledge of situational probabilities in decision-making.

In this respect, this study aimed to address differences among handballers belonging to two different tiers (i.e., national first- (A1) or second-tier (A2) in processing situational probabilities information related to four game situations. The following hypotheses were tested: (1) athletes who played in the first-tier Italian handball league (A1) analyzed game situations with greater accuracy and technical correctness than players of the second-tier league (A2); (2) there is a direct relationship between the membership to a tier and accuracy and technical correctness in athletes' knowledge of situational probabilities in game situations with different level of complexity.

2. Materials and Methods

2.1. Design

An analytic cross-sectional design was used to analyze elite handballers' decision-making components (i.e., time of responses and its accuracy and technical correctness) in processing situational probability and contextual information. Data were acquired in the initial phase of the season, specifically during October and November.

2.2. Participants

A convenient sample of 38 Italian handball players (male = 22, female = 16, age: 25.6 ± 6.5 years) was involved in this study. There were 11 athletes playing in the first-tier Italian league (A1, male = 11; age: 23.5 ± 5.7 years) and 27 athletes playing in the second-tier Italian league (A2, male = 11; female = 16, age: 26.5 ± 6.7 years).

A request for participation in this study was sent to seven different handball teams registered in the Italian first- or second-tier league and located in Sicily (Italy). Five teams approved participation in this study and were enrolled. Players from these teams were included in the study if they were registered with the teams during data gathering and they provided informed consent. Players were excluded from the study if they did not provide informed consent.

Because participants were all involved in the national tournaments related to the best level of Italian handball championships, even if they played in two tiers of this level, we defined these athletes as elite according to the indications provided by previous studies [28,29].

2.3. Assessment Protocol

Two videos and four problem-solving situations, answer sheets, and observation schedule sheets were used to record and assess the responses of the players.

2.3.1. Game Situations

Videos were selected by two handball coaches concerning two different game sequences with increasing difficulty. The situations were related to offensive/defensive sequences in unbalanced conditions of opponents and teammates. The temporal occlusion paradigm was used to stop the sequence before the final action was performed [17,30–32]. Athletes were asked to examine the game sequences to anticipate the possible next adequate actions related to a player indicated in the video with a red arrow. Two coaches independently selected videos from international handball competitions and extracted offensive or defensive game sequences. The selection criteria were related to (1) offensive or defensive game sequences, (2) unbalanced conditions of teammates or opponents, and (3) multiple options of available responses. Therefore, two game sequences were selected: the first game sequence was selected from the match played by Hypo Niederösterreic (Austria) vs. Lada Togliatti (Russia) during the 2007/08 Women's EHF Champions League; the second sequence was selected from the match played by Denmark vs. Norway (i.e., national teams) in the 2008 European Men's Handball Championship held in Norway. For each game sequence, an offensive and a defensive player was indicated with a red arrow in the frame preceding the final stage. Then, two images of the same video were shown separately to the sampled players, one related to the offensive player and one related to the defensive player (see Figures 1–4 for more details). The second video was more complex due to the greater number of potentially available responses.

Figure 1. Offensive game situation which requires a decision in an easier scenario (Game Situation 1).

Figure 2. Defensive game situation which requires a decision in an easier scenario (Game Situation 2).

Figure 3. Defensive game situation which requires a decision in a complex scenario (Game Situation 3).

Figure 4. Offensive game situation which requires a decision in a complex scenario (Game Situation 4).

2.3.2. Written and Verbal Reports and Observation Schedule Sheets

The answers were provided individually by each athlete in written form on an answer sheet, and verbal responses were also recorded [28]. The verbal responses were examined by one of the authors of this study and then transcribed. Observation schedule sheets were used to note aspects not detectable by voice recording (such as posture, gestures, or other nonverbal expressions). The response's accuracy and technical correctness of the answers were rated by two handball coaches. According to the indications provided by Wiman and colleagues (2010), the two coaches were chosen because of their level of experience (i.e., national ranking) and their lengthy training experiences (more than 10 years) [33]. Coaches did not train the athletes at the time of administration. The level of agreement between coaches' evaluation of responses was 97%.

Accuracy refers to the skill to give a detailed response to the situation. Previous studies considered response's accuracy a factor tied to the expertise [18]. However, an accurate response may not necessarily be the best response [15]. Response's accuracy was rated on a scale from 0 to 2, in which 0 corresponds to "not at all accurate", 1 corresponds to "accurate", and 2 corresponds to "very accurate".

Technical correctness refers to the application of technical skills in relation to the specific task to find "solutions" that score a point [34]. Technical correctness was rated on a scale from 0 to 3 (0 = incorrect; 1 = partially correct; 2 = correct; 3 = correct and original). Response times were also measured, starting from the exposure of the last frame of the video at the end of each athlete's response. Finally, each athlete specified his/her expertise as "Years of practice" according to the following options: 0 = less than 1 year; 1 = 1–3 years; 2 = 3–5 years; 3 = more than 5 years.

2.3.3. Procedures

This study was conducted after requesting the cooperation of the participating team coaches and obtaining the approval of the teams' managers. Participants were assessed individually in a single session before training. Videos and answer sheets were administered by a researcher of this study, which also recorded athletes' answers using a voice recorder and an observation schedule sheet. The study was conducted according to the Declaration of Helsinki, and the Faculty Ethical Board of the Kore University of Enna approved this study's design and the methodological procedures used. Before filling in the answer sheet, the participants received general information about the study objectives, anonymity, data collection, and confidentiality of their responses. All the participants expressed their agreement and voluntary participation in a written consent form. Assessment was carried out individually in a room close to the gymnasium where training was taking place. After receiving instructions for filling out the answer sheet, the athletes were asked to watch the videos on the computer. Each video was shown once, and the four images (i.e., two for each video) were shown separately. Athletes had to analyze the image indicating a player and write down what they would have done in his or her place and why. In detail, players saw the first video and immediately saw the first image and gave their answer; then, they saw the second image of the same game situation. After the second response was completed, the same procedure was repeated for the second video (i.e., game situations three and four).

2.4. Data Analysis

Data were preliminarily checked for accuracy, missing values, and univariate and multivariate outliers. Then, data were also verified according to the assumptions (i.e., multicollinearity, homoscedasticity of residuals, and the ratio between subjects and independent variables) requested for MANOVA and multiple logistic regression analysis. MANOVA was performed for each game situation to assess the multivariate effects of independent variables (i.e., time, accuracy, and level of technical correctness of responses) on players of different tiers (i.e., A1 vs. A2). Then, if a general model was significant, one-way ANOVAs were computed to assess differences between players of two tiers (i.e., A1 and A2) for each independent variable. For each significant difference, we reported mean differences (MD), its 95% Confidence Interval (95% CI), and Cohen's d with its 95% CI as an effect size measure. For each game situation, a Logistic Regression model was estimated in order to explore the predictive contribution to the tier membership of accuracy and technical correctness of responses. Effect sizes (η2) were reported for the MANOVA main effect model and interpreted with the following cut-offs: 0.01 = small, 0.06 = medium, and 0.13 = large [35]. Cohen's d (ES) was interpreted with the following cut-offs: 0.2 = small; 0.5 = medium; 0.8 = large [35]. All analyses were conducted with Statistical Package for the Social Sciences 28.0 (IBM Corporation, Armonk, NY, USA), Stata 11.0 (StataCorp. 2009. Stata Statistical Software: Release 11. College Station, TX, USA: StataCorp LP), and JASP (version 0.17.2 for Apple Silicon). The level of significance was 0.05.

3. Results

Data screening revealed no violations of univariate and multivariate normality assumptions. Kurtosis and skewness indices were within ±2. A z-point transformation was performed to allow comparison among scores with different scales.

Descriptive statistics of participants' age, years of practice, and training frequency are shown in Table 1.

Table 1. Descriptive statistics of participants' age, years of practice, and training frequency.

Tier	Gender	Variables	Min	Max	Mean	SD
First	Male (n = 11)	Age (years)	18	35	23.55	5.70
		Years of practice	2	3	2.91	0.30
		Training frequency (time per week)	3	5	4.64	0.81
Second	Male (n = 11)	Age (years)	18	38	26.91	6.80
		Years of practice	2	3	2.91	0.30
		Training frequency (time per week)	2	5	3.27	0.79
	Female (n = 16)	Age (years)	17	40	26.19	6.90
		Years of practice	1	3	2.79	0.58
		Training frequency (time per week)	3	5	3.44	0.63

Note: SD = standard deviation.

Figure 5 shows, for each game situation, the frequency of answers provided by the athletes. First-tier athletes always provided at least one answer in game situations one and two; in game situation three, the same players provided only one answer, while in game situation four, three of them provided two answers.

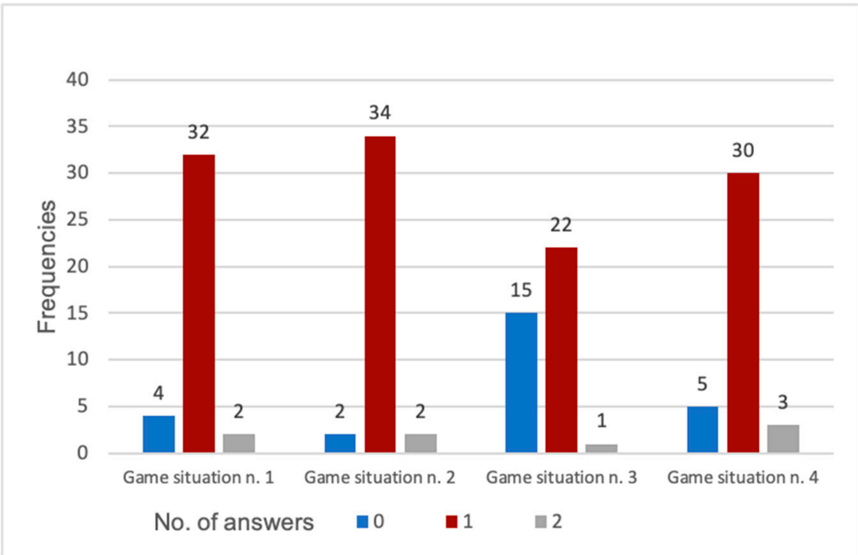

Figure 5. Number of options found by the athletes to the four videos (overall sample).

MANOVA revealed significant general differences between players belonging to the two tiers in each of the considered game situations: game situation 1: Wilks's λ = 0.671, F (3, 34) = 5.54, p = 0.003, and η^2 = 0.33; game situation 2: Wilks's λ = 0.427, F (3, 34) = 14.79, p < 0.001, and η^2 = 0.57; game situation 3: Wilks's λ = 0.48, F (3, 34) = 9.34, p < 0.001, and η^2 = 0.52; game situation 4: Wilks's λ = 0.43, F (3, 34) = 14.44, p < 0.001, and η^2 = 0.57.

Table 2 shows the results of one-way ANOVAs for each independent variable according to each game situation.

Players from A1 had significantly higher means in response times and accuracy scores than A2 athletes in all the situations considered. The effect size of these differences ranged from moderate to high. In the most complex offensive problem (game situation 4), there was also a significant difference in technical correctness, with higher averages in first-tier athletes, even if the effect size was at least moderate.

Table 2. Comparison of time, accuracy, and technical correctness scores between first- and second-tier players for each match situation.

Game Situation	Variables	First Tier		Second Tier		Comparison			
		M	DS	M	DS	MD (95% CI)	F	p	ES (95% CI)
Game Situation 1—Offensive Process—Low Complexity	Time (s)	240.73	108.49	129.75	68.61	110.98 (51.74, 170.22)	14.43	<0.001	1.36 (0.56, 2.15)
	Accuracy	1.92	0.30	1.30	0.61	0.62 (0.24, 1.00)	11.22	0.002	1.16 (0.41, 1.92)
	Technical correctness	1.50	1.00	1.00	0.877	0.50 (−0.14, 1.14)	2.48	ns	
Game Situation 2—Defensive Process—Low Complexity	Time (s)	207.71	86.82	119.26	45.89	88.46 (44.84, 132.07)	16.92	<0.001	1.47 (0.66, 2.28)
	Accuracy	1.83	0.39	1.11	0.42	0.72 (0.43, 1.01)	25.32	<0.001	1.75 (0.93, 2.56)
	Technical correctness	1.33	0.89	0.65	0.85	0.68 (0.07, 1.29)	5.14	0.03	0.79 (0.6, 1.52)
Game Situation 3—Defensive Process—High Complexity	Time (s)	223.83	88.51	100.12	51.45	123.72 (71.65, 175.78)	23.70	<0.001	1.84 (0.92, 2.77)
	Accuracy	1.58	0.52	1.05	0.70	0.53 (0.05, 1.01)	5.06	0.03	0.83 (0.04, 1.62)
	Technical correctness	1.27	0.90	0.79	0.85	0.48 (−0.19, 1.61)	2.13	ns	
Game Situation 4—Offensive Process—High Complexity	Time (s)	210.04	77.12	115.94	68.23	94.09 (42.33, 145.85)	13.62	<0.001	1.33 (0.53, 2.13)
	Accuracy	1.83	0.39	0.93	0.55	0.91 (0.55, 1.26)	26.59	<0.001	1.79 (0.97, 2.61)
	Technical correctness	1.33	0.88	0.74	0.81	0.59 (0.01, 1.18)	4.17	0.048	0.71 (−0.01, 1.43)

Note: M = mean; SD = standard deviation; MD = mean difference; ES = effect size (Cohen's d); CI = confidence interval.

Logistic regression analyses were conducted to predict the membership to a tier (i.e., first-tier was set as baseline) using accuracy and the technical correctness of responses as predictors. In each game situation, a significant regression model resulted, and its main characteristics are described in the following list:

- Game situation 1: $\chi^2 = 10.39$, $p = 0.005$, McFadden pseudo-$R^2 = 0.223$;
- Game situation 2: $\chi^2 = 24.18$, $p < 0.001$, McFadden pseudo-$R^2 = 0.529$;
- Game situation 3: $\chi^2 = 6.55$, $p < 0.04$, McFadden pseudo-$R^2 = 0.171$;
- Game situation 4: $\chi^2 = 27.58$, $p < 0.001$, McFadden pseudo-$R^2 = 0.594$.

According to pseudo-R^2 scores and their interpretation (i.e., values closer to 1 indicating better fit), the models obtained for game situations 2 and 4 seemed to be better. Logistic regression coefficients are reported in Table 3 for each game situation.

Table 3. Logistic regression coefficients for each model (tiers of logit and accuracy and technical correctness as predictors).

		Odds Ratio	SE	z	p-Value	Confidence Interval (95%)	
Game Situation 1	Accuracy	4.143	2.893	2.04	0.042	1.054	16.282
	Technical Correctness	1.405	0.651	0.73	ns	0.566	3.487
Game Situation 2	Accuracy	16.548	16.631	2.79	0.005	2.308	118.644
	Technical Correctness	0.493	0.437	−0.80	ns	0.087	2.797
Game Situation 3	Accuracy	3.165	1.802	2.02	0.043	1.037	9.660
	Technical Correctness	1.747	0.807	1.21	ns	0.0706	4.322
Game Situation 4	Accuracy	12.579	10.144	3.14	0.002	2.589	61.106
	Technical Correctness	2.735	1.34	2.05	0.040	1.047	7.145

Note: ns = not significant; SE = standard error.

In game situations 1 to 3, the accuracy of response was the only significant predictor. The relative ORs indicate that when the accuracy is raised by one unit (i.e., one level of accuracy), the membership to tier 1 is 4.4, 16.6, and 3.16 more times likely, respectively. In the most complex game situation, both accuracy and technical correctness of response resulted in significant predictors, even if the likelihood of belonging to the first tier seems more dependent on the accuracy of response (OR = 12.58) than technical correctness (OR = 2.73).

4. Discussion

The aim of this study was to analyze the time of responses and its accuracy and technical correctness in processing situational probability and contextual information among handball players belonging to two different tiers (i.e., first and second national tiers).

First-tier athletes showed greater accuracy in their responses than second-tier athletes, despite spending more time in all the game situations analyzed. The difference between first- and second-tier athletes in technical correctness seems to emerge only in two game situations (i.e., 2 and 4). Therefore, the first hypothesis can only be partially confirmed. The results of this study confirmed that the majority of first-tier athletes processed at least one appropriate option in the processed game situations. It should be noted that the accuracy and technical correctness scores refer to the answers given. As the complexity of the game situations increased, differences emerged between first- and second-tier athletes. In detail, 39.47% of the total participants (15 out of 38 athletes) did not provide any response in the most complex defensive situation (i.e., game situation 3). All first-tier athletes provided only one solution to the defensive situation in the most complex scenario and also showed greater technical correctness than second-tier athletes. In game situation 4, related to the most complex offensive process, only three first-tier athletes provided two solutions. Therefore, the current results seem to confirm the findings of Jonhson and Raab (2003) [15] on the use of take-the-first heuristics. Handball players must make such decisions under time pressure [36]. Regarding this, Ward and colleagues [37–41] have explained qualified perceptual anticipation through long-term working memory theory [36]. Experts can create mental representations of the current situation that are preserved and remain available in the long-term memory thanks to recovery signals in the working memory. Moreover, with the continuous change in dynamic situations, these representations are updated thanks to the new information received. In this way, the subsequent request for recovery can be anticipated, and the performance can be performed, monitored, and controlled [36]. Other empirical evidence, however, explains this phenomenon by employing the recognition–primed decision (RPD) [42]. According to this idea, step by step, individuals can gain more experience within a domain and recognize familiar patterns within a situation. These models determine, in expert subjects, good associated responses. Specifically, when they recognize a model, they can generate this response without further need to generate others [36]. In this sense, some authors [16,43] have confirmed that qualified handball players generate few response options, and, as hypothesized in their study, the first option is evaluated as having a higher quality (take-the-first heuristic). Accordingly, in this study, the players of the first tier provided fewer and more accurate responses in the complex defensive situation. In the more complex offensive situation, first-tier athletes showed greater accuracy of response and technical correctness than second-tier athletes. All of the first-tier athletes provided at least one answer, and three of them gave two answers. For these reasons, we believe using time pressure constraints could be adequate to train the anticipatory skill of all athletes. According to Buszard (2022), however, temporal pressure does not always generate learning [44]. The author, inspired by the concepts of fragility and anti-fragility [45] and by defining a mathematical function, explained the existence of a non-linear relationship between temporal requests and the development of anticipatory capacity. There are situations where this ability does not experience any change because the time pressure is insufficient; others where the increase in time pressure determines a good level of learning; other situations where high levels of temporal pressure lead to a positive change in anticipation capacity but with the risk of a reversal if the pressure increases again; and finally, there are situations where a regression of anticipation capacity is possible because the temporal pressure is too high [44]. Also, the results of this study would seem to indicate that first-tier athletes have better skills in analyzing defensive situations.

Furthermore, handball players, as well as the players of other team sports, are continually called upon to answer technical and/or tactical questions, such as "What does my opponent want to do? Will I be able to overcome it? Which solution or option is the simplest?" [17]. Clearly, the complexity of the required answers grows with the increase in championship tiers. In this respect, logistic regression analysis revealed that the membership to the first tier mainly depended on the level of accuracy in the provided responses, which seems to indicate that players of this tier were able to provide responses by gathering information from multiple sources within the context of the game analyzed. The level of technical correctness resulted as a significant predictor of the first-tier membership only in the game situation with the highest level of complexity (i.e., game situation 4). In this case, an athlete had 12.16 more chances to move forward to the first tier for each increase in the accuracy of his/her responses and 2.7 chances for each increase in technical correctness. Therefore, the second hypothesis can also be partially confirmed.

These results may depend on several factors. First, players who belong to the first tier have a greater repertoire of possible actions in their long-term memory. Second, they are better at connecting past game actions, decision-making outcomes, and cue recognition, adjusting their decisions to current risks and probabilities [13]. And finally, they could differentiate strategies depending on the offensive and defensive situation.

In defensive situations, players belonging to the first tier are likely to choose the most effective action by recognizing a pattern of play as part of their long-term memory store. In addition, although athletes may have focused their training more on offensive situations, players of the first tier showed more technical correctness because they seemed to have a wider knowledge of situational probabilities in all game situations.

Hence, assessing decision accuracy under constrained conditions is helpful, but it is only one of many factors of the appropriateness of a decision. The quality of a decision is determined by the performance's result, but this decision does not necessarily imply that the performed action is correct or it is the best [28]. Therefore, a way to fix this problem seems to be for players to reanalyze their own decision. Accuracy and technical correctness skills should be considered together in decision-making training. In this respect, it has been pointed out that the skills required in dynamic decision-making are comparable to those of insight problem solvers [46]. Insight problems require that athletes have skills in reorganizing the game situation and the ability to connect players and actions in an original and effective way [7]. And even if the decision-solutions in a situation may be more than one, an expert should be able to choose the best among them. According to Vickers (2007), what athletes observe when they perform an action is influenced by constraints related to the visuomotor system, the task they face, and the environment [7]. Because these constraints are found in real-world contexts, these allow us to understand decision-making processes and sports performance on a different level. When Vickers' Decision Training Model was applied to groups of athletes and coaches with different ages and abilities, learning was inferred from the correctness of a decision and the resulting action, which accomplishes a high level of physical performance. A Decision Trainer conducts training in which athletes learn to make decisions in a variety of sports situations. Decision-based training help athletes anticipate events, pay attention to relevant sensory information and retrieve the best response from memory, focus on the appropriate event at the right time, and make the most effective decision in settings characterized by even high stress levels. Instructions provided by the coach should be addressed to the athlete to direct attention to critical information about performance, the field of play, and ongoing tactical events. Communication between coach and athlete should reduce the number of direct suggestions on actions to be taken and stimulate the athlete to find corrective solutions independently. To increase cognitive efforts, athletes should be asked questions that demonstrate understanding and knowledge of specific tactical skills and tasks to be performed. This approach of training emphasizes complexity, which relates to and tends to replicate the situations in the sports game in which the athlete is challenged. Exercises do not progress from the simple to the more complex, but tactics-based training is implemented and skills are improved through tactically oriented exercises that simulate games or competitions. Decision training involves a high cognitive effort of anticipating, planning, adjusting, and interpreting motor performance, which parallels physical, technical, and tactical training [47]. Our protocol and results are in agreement with and somewhat support the model of the decision-making training proposed by Vickers. Therefore, from a practical point of view, we hypothesize that the decision-making training process has to be improved beyond the simple video viewing, and attention should be paid to (a) discussing with players about potential new links they could build considering the relevant information derived from game situation analysis and accounting for the technical correctness of previously provided responses; (b) using temporal occlusion paradigm by manipulating the degree of temporal pressure to improve the athletes' anticipatory abilities; (c) providing adequate and balanced training about the analysis of offensive and defensive game situations.

Limitations of the Study

As exposed by Bonnet in 2020, the cognitive and naturalist approaches are complementary [17]. Because our assessment approach did not account for this integration, it could be considered as a limit of this study. From a methodological standpoint, years of practice were collected through a categorical scale of measurement, with a grouping of years of practice into classes (e.g., 0 = less than 1 year; 1 = 1–3 years; 2 = 3–5 years; 3 = more than 5 years). This had consequences for the type of data analysis available and reduced the variability between first- and second-tier players by minimizing differences in this variable. Finally, the sample size and the roles in which athletes claimed to play (i.e., several handballers played multiple roles) prevented us from considering the role in interpreting the results. This could be considered a third potential limit of this study and, at the same time, a starting point for future research.

5. Conclusions

The results of this study could lead sports coaches and physical education teachers to design training sessions related to the situational analysis of gameplay to improve decision-making processes. Our protocol and results are in agreement with and somewhat support Vickers' decision-making model that emphasizes the complexity of real sports game situations. Furthermore, to extend the training of decision-making skills, we suggest supporting players throughout a reflection on building new links based on the relevant information derived from the game situations analyzed by taking into account both the accuracy and technical correctness of the responses.

In addition, balancing offensive and defensive actions within a training process could also be useful for increasing players' knowledge base on all the situational probabilities in the two main categories of actions. Finally, in association with the assertions of Buszard (2022) [44], the use of temporal occlusion can also improve one's ability to anticipate in a real game context [48–51].

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