SECTION – EXERCISE SCIENCES

(1.3) DOI: 10.5604/ 01.3001.0014.8208

EVALUATION OF COOPERATION LEVEL AMONG PLAYERS IN MODELLING SITUATIONS FOR SCORING

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Authors' contribution:

A. Study design/planning
B. Data collection/entry
C. Data analysis/statistics
D. Data interpretation
E. Preparation of manuscript
F. Literature analysis/search
G. Funds collection

Keywords: cooperation, creative teaching, game objective

Abstract:

The essence of effective training in a sports game is the use of means and forms of teaching in the organisation of a game, which most faithfully reflect the environment of the player's actual activity in natural conditions. Thus, there is a need to accurately identify the conditions of competition in a sports game. One of the types of such activities is observation, which being an elementary method of cognition, based on deliberate, targeted and intended as well as systematic perception of the studied subject, process or phenomenon.

Research objective and questions

The aim of the work is to assess the level of absolutely dependent cooperation (synergy) during a team sports game in changing game situations, in achieving the highest offensive objective, i.e. scoring a goal.

– Is the effectiveness of achieving the highest objective of the game in offensive actions (i.e. scoring a goal) dependent on the level of player synergy?
– Is the size of the conflict in the sports objective of the game dependent on creative player involvement?

Material and test method

– In the work, detailed observation was carried out with regard to players' actions in achieving the highest objective of the game, i.e. scoring a goal. The observation concerned analysis of 134 goals scored in 61 UEFA Champions League and European League football matches in 2009–2020.
– In this study, the method of observation was used, with the possibility of repeatedly observing events being the subject of research.
– In the research analysis, the use of film material of recorded games on a DVD was taken into account, where the observed effects were applied to an observation sheet.
– The situations in which goals were scored and the research material comprised teams that competed in a given match.
– The observation of scoring goals took the type of situation and level of interaction between players into account.

Results

Analysis of the obtained results can be inferred:

1. In achieving the highest objective of offensive actions, a high level of synergy prevails, requiring anticipation of events.
2. The high level of synergistic activities increases with the difficulty of situational tasks.
3. Due to the multi-faceted nature of team games, the player's training process should also affect his/her mental sphere.

Introduction

The essence of effective training in a sports game is the use of means and forms of teaching in the organisation of the game that most faithfully reflect the environment of the actual operation of a player in his/her natural conditions. Thus, there is a need to accurately identify the determinants of competition in a sports game. One of the types of such activities is observation, which, being an elementary method of cognition, is based on

purposeful, directed and intended, as well as systematic perception of the examined object, process or phenomenon [1]. Based on the definition of a sports game [2,3,4], it may be noticed that the actions of players are intentional activities that require not only proper physical preparation but, above all, special activation of mental processes (internal action), which, due to the need to undertake appropriate decisions, constitute the superior link in achieving the goal of the game [5,6] - Fig.1.

tion of group game effectiveness is a function of the individual abilities of players and merging abilities among this group. It seems that these factors are largely based on the understanding of the game (knowledge about the game, decision-making efficiency), hence, it may be deduced that it is more effective to achieve a goal when individual actions of players are intentionally and rationally integrated into group activities that depend on the degree of cooperation among players [8].

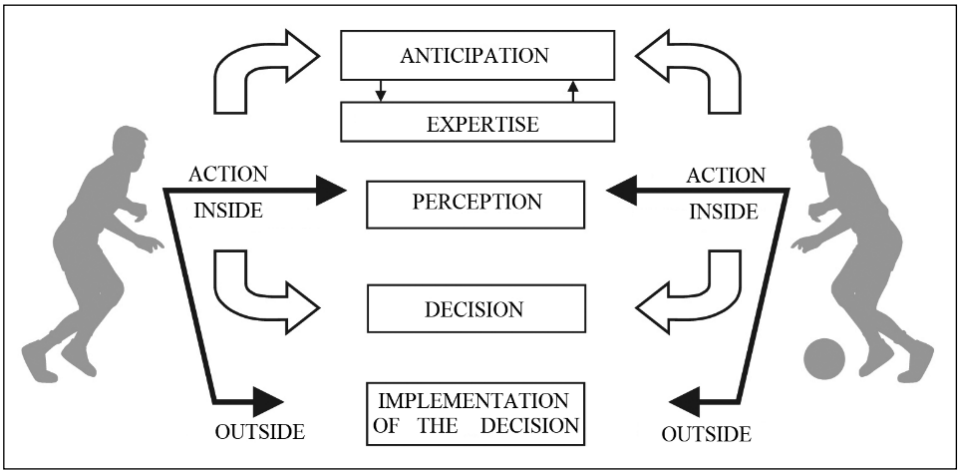

Fig. 1. Elements characterising a player's actions in carrying out the game objective (according to: [2])

It follows from the above that the effectiveness of action is the systematic reception, processing and production of information in various sports game situations [7]. It seems that this process is of significance not only in the actions of an individual player, but above all, in cooperation - that is, group action.

According to Naglak [2], group action comprises several players (the number is regulated by the rules of a given discipline), performing tasks together and cooperating due to a specific goal. This group is an integral whole, where each of its members acts within a certain scope, which means that the players fulfil more or less dependent roles. Their actions consist of multiple scopes, which means that each player, while performing different functions, always takes the actions of their partners into account [2]. In group action, a player should understand the relationships existing between him/her and his/her partners. S/he should not only know how to act individually in certain situations, but also be aware of the possibilities of actions regarding partners and the opponent; only then, according to Naglak [2], does the ability to act tactically appear, consisting in the fact that the player is able not only to implement his/her own intentions, but also to coordinate them with the actions of partners. S/he can see his/her own mistakes, those of partners and opponents, and learns to avoid them. It is assumed that the predic-

A competitor in a group is only a part of it as much as this person actually performs functions on its behalf. There is a synergistic effect when each of the group members is most greatly committed to achieving the game objective. Synergy in a team sports game is an equifinal system of dependent effects facilitating and enabling (organising) the achievement of the game objective. These synergy forms are part of so-called external synergy. The level of its manifestation is determined by the interdependent individual dispositions of players, creating equifinal systems of synergistic dispositions (internal synergy).

Assuming that a team game is a sequence of diverse situational actions, both individual and, above all, related to a group, hence, in this study, it was attempted to define the structure of this specific activity. Considering also the different levels of cooperation (anticipatory, simultaneous, consequent) - Panfil 2008, it was attempted to define the nature of this activity in terms of the level of intentionally achieving the main goal of the game for offensive actions.

Recognition of this issue in multi-scope activities is extremely important (the specificity of the game), therefore, these activities can significantly facilitate the process of rational control among players in a team sports game.

1. Research objective

The **aim of the study** was to assess the level of absolutely dependent cooperation (synergy) for a team sports game in changing game situations, in the implementation of the highest offensive objective, i.e. scoring a goal.

In the work, the following **research questions** were posed:

- Does the effectiveness of achieving the highest objective of the game in offensive actions (i.e. scoring a goal) depend on the level of synergy among players?
- Does the degree of conflict in the game objective depend on the involvement of a creative player?

Hypothesis:

Actions that lead to scoring a goal in a football game, due to the high level of conflict between the sports goal and the high level of conflict in the sports objective, require efficiency in action based on a creative way of solving a movement task.

Research materials and methods

In this work, a detailed observation of players' actions in achieving the highest objective of the game, i.e. scoring a goal, was conducted. The observation concerned analysis of 134 goals scored in 61 football matches of the Champions League and the European League in 2009-2020.

In the author's research, the method of recorded observation was used, with the possibility of multiple observations of events being the subject of the research.

The research analysis included the use of film material from the recorded matches on a DVD, where the observed actions were marked on an observation sheet.

The observed situations concerned those in which goals were scored, and the research material was the team that achieved sports victory in a given match.

As for the research method, an observation sheet was used, where in the appropriate boxes under a given issue (observation parameter), all observed facts, events and circumstances related to a given issue were noted - Fig. 2.

In the research observation, assessment of absolutely dependent cooperation was included, which, according to the concepts by Panfil [3] and Duda [9], concerned the different levels of players' cooperation:

- **Anticipatory coordination (AC)** - situation in which interdependent actions are performed in advance, i.e. the start of the next task takes place in the final phase of the preceding activity, even before its completion.

In the observational analysis, a **positive activity in this action** was when the player scoring a goal made a "freeing" move, stepping into a convenient shooting position in the final phase of the partner's action (just before its completion), creating a positive situation for passing the ball.

- **Simultaneous coordination (SC)** - situation in which interdependent actions are performed simultaneously, i.e. the next task is begun at the same time, i.e. at the end of the previous one.

In the observational analysis, a **positive activity in this action** was when the player scoring a goal made a "freeing" move, shifting into a convenient shooting

Classification of match according to result of meeting: Hard, Easy, **Aligned**			**Sports class: Champions League – 2016/17 season**	
Teams playing and match result: Villarreal CF 1:2 AS Monaco			**Teams playing and match result: Villarreal CF 1:2 AS Monaco**	
Type of coordination / Order of goals	Anticipatory coordination	Simultaneous coordination	Consequent coordination	Type of situation
1	X			Certain
2		X		Uncertain
3		X		Risky
Total 3	1	2		

Fig. 2. Observation sheet presenting game characteristics in offensive cooperation

position, simultaneously at the moment that the partner's action ended, creating a positive situation for passing the ball.

- **Consequent coordination (CC)** - situation in which interdependent actions are performed in a consequent system, i.e. the beginning of a following task depends on the final result of the previous one.

In the observational analysis, a **positive activity in this action** was when the player scoring a goal made a "freeing" move, shifting into a convenient shooting position when the partner had gained full freedom (possibility) to pass the ball.

In the research process, the activities described above were carried out by competent judges, selected using the Delphi method [4] and concerned analysis of goals scored in 3 specific situations:

- **Certain situations** – those in which the number of attackers exceeded the number of defenders.
- **Uncertain situations** – those in which the number of attackers was equal to the number of defenders.
- **Risky situations** - those in which the number of attackers was lower than the number of defenders.

The characteristics of goals scored at this level of research concerned the observation of easy matches, which, in the evaluation of a measurable sports result, ended with a score of at least 2 goals.

In order to answer the formulated research questions and to verify the adopted hypothesis, the following calculations and statistical methods were used - basic statistical calculations were implemented in the evaluation of the research results: arithmetic mean, standard deviation, coefficient of variation and the significance level of differences was determined using the Student's *t*-test [10].

Results

By analysing the research results, an attempt was made to characterise the mode of action in terms of the level of intentionality (simultaneous, subsequent and anticipatory coordination), and in terms of the purpose of the task. The aspects of these assumptions required not only high motor skills but, above all, high mental involvement (interpreting the game, understanding partner's intentions).

Presenting the results of research, analysis of actions in scoring goals in certain situations, in actions where the dominance of players in offensive action, was dominant.

For the observed matches in these activities, 36 goals were scored (Tab.1), of which, 7 goals (19.4%) were scored via consequent cooperation, 15 goals (41.7%) were scored during simultaneous cooperation, while 14 (38.9%) were scored in the course of anticipatory coordination.

From the analysis of the presented data for actions in easy situations, it can be noticed that actions performed while carrying out consequent coordination, which in Panfil's [3] opinion are characterised by only a small level of anticipation processes, were the lowest value in terms of percentages (Fig. 3).

In the statistical analysis (Tab. 2), it can be noticed that the obtained values indicate significant differences ($p<0.05$) but only in the comparison of anticipatory and consequent coordination. Analysis of the variance index also shows that the goals scored in easy situations were dominated by anticipatory and simultaneous coordination. Thus, it may be concluded that the majority of goals (80,6%) in easy situations, as stated by Naglak [2] and Panfil [3], were scored with a high degree of anticipation of the partners' actions.

Further analysis in the research process concerned the characteristics of players' cooperation when scoring goals in uncertain situations (Tab. 3). In assessment of the situation, these were goals scored balancing the actions of: forwards - defenders.

For the observed matches in these activities, 54 goals were scored (Tab. 3), of which 12 goals (22.2%) were scored during consequent operations, 20 goals (37%) were scored via simultaneous coordination op-

Tab. 1. Qualitative analysis of scored goals with regard to coordination of action in certain situations

Goals	Type of coordination in action		
No.	Anticipatory coordination	Simultaneous coordination	Consequent coordination
1	0	1	0
2	0	1	0
3	1	0	0
4	0	1	0
5	0	0	1
6	0	1	0
7	1	0	0
8	1	0	0

9	1	0	0
10	0	1	0
11	0	1	0
12	0	1	0
13	0	0	1
14	0	1	0
15	0	1	0
16	1	0	0
17	0	0	1
18	1	0	0
19	0	1	0
20	1	0	0
21	0	1	1
22	1	0	0
23	0	0	0
24	0	0	1
25	0	1	0
26	0	1	0
27	1	0	0
28	0	0	1
29	1	0	0
30	0	1	0
31	0	0	1
32	1	0	0
33	0	1	0
34	1	0	0
35	1	0	0
36	1	0	0
Total / value %	**14 / 38.9%**	**15 / 41.7%**	**7 / 19.4 %**

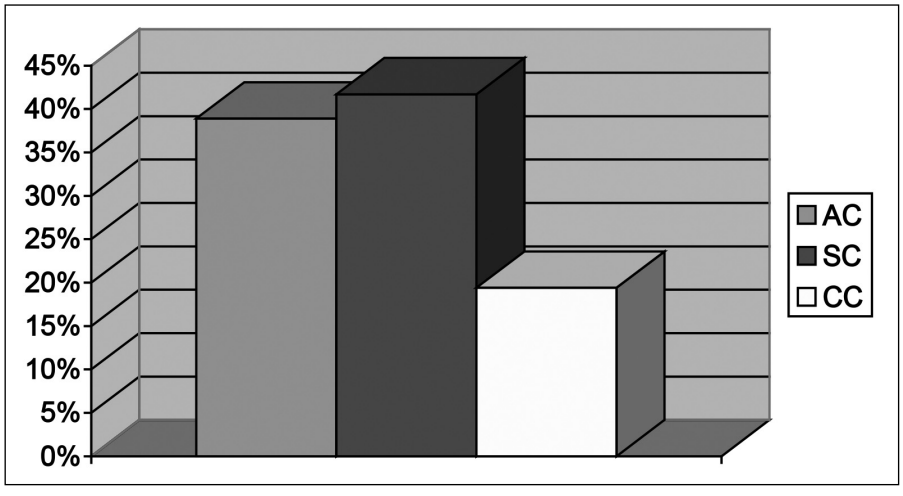

Fig. 3. Percentage characteristics of scored goals by competitors according to coordination of action in certain situations

Tab. 2. Value of differentiating actions in scoring goals, considering type of coordination in certain situations

Parameters		Type of coordination in action		
		Anticipatory coordination	Simultaneous coordination	Consequent coordination
Arithmetic mean		0,39	0,42	0,19
Standard deviation		0,37	0,40	0,18
Coefficient of variation		127,13	120,00	206,43
Degree of significance in differences	AC - SC	0,406		
	AC - CC		0,020*	
	SC – CC			0,035*

** $p < 0.05$

Tab. 3. Qualitative characteristics of scored goals considering coordination of action in uncertain situations

Goals	Type of coordination in action		
No.	Anticipatory coordination	Simultaneous coordination	Consequent coordination
1	0	1	0
2	0	0	1
3	1	0	0
4	1	0	0
5	0	0	1
6	0	1	0
7	0	1	0
8	1	0	0
9	1	0	0
10	1	0	0
11	0	0	1
12	0	1	0
13	1	0	0
14	1	0	0
15	0	1	0
16	0	0	1
17	1	0	0
18	1	0	0
19	1	0	0
20	1	0	0
21	0	1	0
22	0	1	0
23	0	0	1
24	0	1	0
25	0	0	1
26	0	1	0
27	1	0	0
28	0	1	0
29	1	0	0
30	0	1	0

31	0	0	1
32	0	1	0
33	1	0	0
34	0	0	1
35	0	1	0
36	1	0	0
37	0	0	1
38	1	0	0
39	0	1	0
40	0	0	1
41	0	1	0
42	1	0	0
43	0	1	0
44	0	0	1
45	1	0	0
46	1	0	0
47	0	1	0
48	0	0	1
49	1	0	0
50	0	1	0
51	1	0	0
52	0	1	0
53	1	0	0
54	0	1	0
Total / value %	**22/ 40,8%**	**20/ 37%**	**12/ 22,2%**

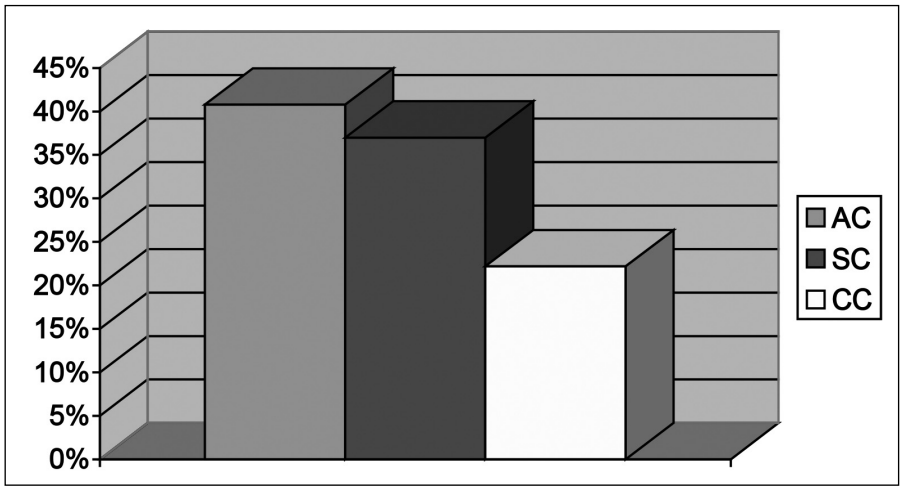

Fig. 4. Percentage characteristics of scored goals according to coordination of action in uncertain situations

erations, while 22 (40.8%) of the goals were scored in anticipatory activities.

In the analysis of the presented data for actions in uncertain situations, it can be seen that actions performed through consequent coordination, which, in Panfil's opinion [3], are not greatly characterised by anticipation processes, obtained the lowest percentage value - Fig. 4.

In statistical analysis (Tab. 4), it can be noticed that the obtained values indicate significant differences ($p<0.05$) in the comparison of activities: the level of anticipatory and consequent coordination, as well as simultaneous and consequent coordination. This fact points to a clear dominance of anticipatory and simultaneous coordination activities in scoring goals during uncertain situations. Analysis of the variability index also indicates that the goals scored in actions of uncertain situations were dominated by cooperation at the level of anticipatory and simultaneous coordination. Therefore, it may be concluded that the majority of goals (77.8%) in uncertain situations, as stated by Naglak [2] and Panfil [3], were scored with a high degree of anticipation of partners' actions.

Final analysis in the research process concerned the characteristics of players' cooperation in scoring goals in risky situations. In the assessment of the situation, these were goals that were scored in conditions of discomfort regarding offensive actions, i.e. with the advantage of the defenders.

For the observed matches in these activities, 44 goals were scored (Tab. 5), of which 8 goals (18.2%) were scored in the consequent operations, 17 goals (38.6%) were scored during simultaneous coordination operations, while 19 (43.4%) were scored in anticipatory coordination actions.

From analysis of the presented data for actions in risky situations, it can be noted that actions in performed during consequent coordination, which, in Panfil's opin-

Tab. 4. Value of differentiating actions in scoring goals considering type of coordination in uncertain situations

Parameters		Type of coordination in action		
		Anticipatory coordination	Simultaneous coordination	Consequent coordination
Arithmetic mean		0,41	0,37	0,22
Standard deviation		0,40	0,36	0,21
Coefficient of variation		122,19	130,02	194,07
Degree of significance in differences	AC - SC	0,348		
	AC - CC		0,019*	
	SC – CC			0,046*

*$p < 0.05$

Fig. 5. Percentage characteristics of scored goals concerning coordination of action in risky situations

Goals	Type of coordination in action		
No.	Anticipatory coordination	Simultaneous coordination	Consequent coordination
1	1	0	0
2	0	1	0
3	1	0	0
4	0	1	0
5	0	0	1
6	1	0	0
7	0	1	0
8	0	0	1
9	1	0	0
10	1	0	0
11	0	0	1
12	1	0	0
13	0	1	0
14	0	1	0
15	1	0	0
16	0	0	1

17	1	0	0
18	0	1	0
19	1	0	0
20	0	1	0
21	0	0	1
22	0	1	0
23	1	0	0
24	0	1	0
25	0	1	0
26	1	0	0
27	1	0	0
28	0	0	0
29	1	0	0
30	0	1	0
31	1	0	0
32	0	1	0
33	1	0	0
34	0	1	0
35	0	0	0
36	1	0	1
37	0	1	0
38	1	0	0
39	0	0	1
40	1	0	0
41	0	1	0
42	1	0	1
43	0	1	0
44	0	1	0
Total / value %	**19 / 43,2%**	**17 / 38,6%**	**8 / 18,2%**

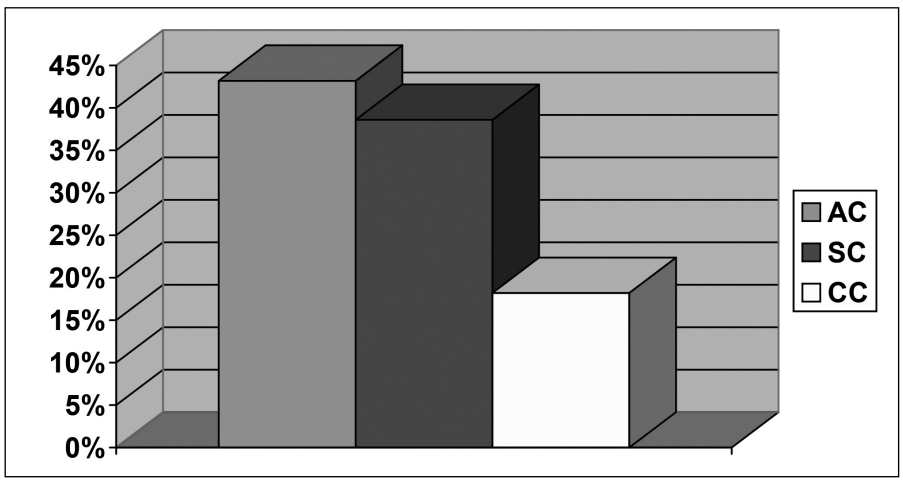

Fig. 5. Percentage characteristics of scored goals concerning coordination of action in risky situations

Tab. 6 - Value regarding significance of differences in scoring goals considering type of coordination in easy matches but risky situations

Parameters		Type of coordination in action		
		Anticipatory coordination	**Simultaneous coordination**	**Consequent coordination**
Arithmetic mean		0,43	0,39	0,18
Standard deviation		0,41	0,37	0,17
Coefficient of variation		116,03	127,48	214,58
Degree of significance in differences	AC - SC	0,334		
	AC - CC		0,005**	
	SC – CC			0,016*

*$p < 0.5$, ** $p < 0.01$

ion [3], are to a small extent characterised by anticipation processes, were the lowest value in percentage terms - Fig. 5.

These observations are also confirmed by statistical calculations (Tab. 6), indicating clear dominance of actions in anticipatory and simultaneous coordination.

This fact shows evident predominance of anticipatory and simultaneous coordination when scoring goals in risky situations. Furthermore, analysis of the variability index also allows to confirm that the goals scored in actions of risky situations were dominated by cooperation at the level of anticipatory and simultaneous actions.

Thus, it may be concluded that majority of goals (81.8%), in risky situations, as stated by Naglak [2] and Panfil [3], were scored with a high degree of anticipation of the partners' actions.

By characterising the cooperation of players in achieving the highest objective, which occurs in offensive actions (scoring a goal), an attempt was made to answer specific research questions:

- Does the effectiveness of achieving the highest goal of the game in offensive actions (i.e. scoring a goal) depend on the level of players' synergy?
- Does the degree of conflict of a sports objective in the game depend on the involvement of a creative player?

In the process of training a player, these questions seem important and legitimate, as they help recognise the problem of effective action in terms of internal and external synergy that occur during a sports game. These activities are characterised by a high level of mental process efficiency [3], hence. it seems that in face of common training for sports games, where accents of mechanical and habitual behaviour dominate [4], these activities allow to pave the path to carrying out effective sports games. Based on the synergy process of players, an attempt was made to determine the levels of cooperation, which, according to Panfil's classification [3], are based not only on the difficulty of completing tasks, but above all, on trying to characterise the cooperation of players based on the level of anticipation in action. This aspect was additionally assessed in certain, uncertain and risky situations, where thought processes may, to a varying degree, dominate action [9].

The obtained research results allow to clearly indicate that in certain, uncertain as well as risky situations that characterise a sports game [2], the effectiveness of cooperation requires a high level of synergy. In this study, confirmation of this thesis was illustrated by the percentage index for effectiveness in scoring goals during selected game situations. These activities require not only high efficiency of external action but, above all, of that internal, based on anticipation and effective perception [2, 3, 11].

Therefore, it can be concluded that in order for better cooperation to take place, players must not only understand each other but, above all, understand the game - have knowledge about the game, which will greatly facilitate decision-making in a competitive sports environment [12]. This regularity sets the directions for organised training, as it illustrates the importance of intellectualising training for the creative action of a player.

Conclusions

1. Achieving the highest objective of offensive action is dominated by a high level of synergy, requiring anticipation of events.
2. The high level of synergistic activities increases with the difficulty of situational tasks.
3. Due to the multi-subject nature of team sports, the process of training a player should also affect his/her mental sphere.

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