The Latent Structure of Soccer in the Phases of Attack and Defense

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A B S T R A C T

With the aim of establishing the latent structure of tactical elements in the attack and defense phases of soccer 117 tactical elements of soccer were defined and their importance assessed by means of 30 variables that determine the basic segments of the game of soccer. 93 attack and 24 defense tactical elements were chosen as the entity sample and described by the 15 variables of the attack phase and 15 variables of the defense phase. Ten competent soccer experts determined the characteristics of the aforementioned entities by means of 30 variables. The experts graded from 0 to 5 the impact of every entity (tactical technique) on the individual variables that describe soccer in its phases of either attack and defense. A high level of inter-expert agreement was reached in regard to the properties of attack and defense techniques, as demonstrated by the objectivity coefficients. According to principal component factor analysis and the Kaiser and Guttman rule a total of five significant latent dimensions were obtained: finishing efficiency, ball possession performance, counter-attack efficiency, combined defense performance, and obstruction and redirection of the opposing team's attack build-up. The research partly resolved the issue of the hypothetical structure of tactical techniques in soccer by dividing the game into phases and sub-phases, attack and defense players' positions, and types (styles) of play in the attack and defense. If it is clear which movement structures have the most significant influence on the efficiency on a particular playing position and performance in the sub-phases and styles of play, it would be possible to create such training operators that will facilitate the formation of the most important motor skills in soccer.

Key words: soccer, tactical techniques, game structure, latent structure, factor analysis

Introduction

Association football or soccer is currently the most popular sport and is increasingly requiring greater motor and energy-supply abilities and the use of quicker and more efficient tactical techniques. Moreover, further development of the game dynamics[1] is expected during the 21st century. Tactical techniques include technical elements applied in different situations such as a variety of gross movements, measures and procedures carried out with the aim of solving certain tasks in the course of the game[2]. The familiarity with the game structure implies understanding of various phases and sub-phases of the

game and individual players' positions, which underpins recognition of specific situations in the game[3]. The flow of the game consists of numerous phases and transisitons from one phase to another, and players are due to perceive them, understand and solve the tasks in the game by using appropriate technical and tactical programs[3–5].

There is a series of research studies on the activity structure and frequency of tactical techniques used in soccer[4,6]. There are also numerous studies that analyse the impact of and correlation between specific tactical

techniques and structural elements and performance of the soccer team[3,7–12]. Furthermore, Sporiš et al.[3] and Jerković et al.[8] carried out a structural analysis of players' positions in soccer on the basis of anthropological characteristics and determined that an all-around quality is expected from the players on the field in every phase and sub-phase of the game. Verlinden et al.[13] classified and registered ball possession in 26 soccer games of the World Cup and found a correlation with six criteria. On the other hand, Ensum et al.[14] determined the factors that characterised successful shots on goal. The research on soccer so far has mostly studied motor abilities, quantified situational parameters and their correlation with success in the game as well as the profiles of particular players' positions[3]. This research studied the qualitative characteristics of tactical techniques, that is, the importance of their contribution to performance in every phase and sub-phase of the game, styles of play and playing positions. It is important to establish the properties of the latent structure of soccer, that is, to acquire a clearer perception of what precedes the players' actions, as this gives an opportunity for the implementation of such training programs focusing on the improvement of physiological abilities as well as technical and tactical skills of footballers, as required by the tasks in the game.

The authors of the present research have not identified any study that establishes the latent structure of tactical techniques in the phases of attack and defense in soccer. However, similar approaches to team ball game sports structure analyses exist in basketball and handball[14,15]. The basic problem in this research was the determination of the importance of the tactical techniques in the phases of attack and defense, whereas the primary goal was to establish the latent structure of the tactical techniques in the phases of attack and defense in soccer.

Material and Methods

Ten soccer experts assessed the importance of tactical techniques that define the structure of soccer. A soccer coach, an expert advisor, a top player or a college professor teaching soccer at the Faculty of Kinesiology, a coach of a soccer team competing in the European Football Club championships, a coach or a member of expert staff of the national soccer team participating in the European Championships or World Cups, a footballer from a team competing in the European Football Club championships or a member of the national team participating in the European Championship or World Cup were regarded experts in the research study. Relying on their own experience and using the assessment system with values ranging from 0 to 5 the experts graded the impact of tactical techniques on the properties (attributes) of soccer, attack and defense.

The entity sample comprised 117 tactical techniques of soccer in the phases of attack and defense (Table 1). If a certain soccer technical element is applied in the training process or the game itself with the aim of advancing the ball, keep it in the possession, take over its posses-

sion, pass it to a teammate or trying to score as well as obstructing the opponent from scoring at any given moment and in any given situation, then the same element represents a tactical technique.

Thirty variables (Table 2) were created that determine the basic elements of soccer in relation to the teams' positions in the game and in the phases of attack and defense, the field zones, game phases, sub-phases of attack and defense and types (styles) of play in the phases of attack and defense. The experts assessed, weighted and graded the importance of each tactical technique with regard to each of these 30 attributes to the game of soccer. The research did not comprise the goalkeeper's positions in the game nor his/her tasks. This will be the subject of future analyses of soccer.

The group of 30 variables was condensed (Table 3) into the groups of variables of game positions, variables of sub-phases of the game, variables of the styles of play and grouped variables together with the arithmetic mean separately for the phases of attack and defense, which resulted in the assessment of the importance of tactical techniques.

The data were processed by means of Statistica (Data Analysis Software System), version 7.1., separately for the tactical techniques of attack and defense. Descriptive parameters (arithmetic mean, standard deviation, the minimum and maximum values and their range) were calculated for the assessment of the importance of each tactical technique in every property (attribute) of the game and its segments together.

Prior to the factor analysis, the normality of the distribution of variables was examined by the Kolmogorov-Smirnov test, the assymmetry coefficient and by the measurement of the values of skewness and kurtosis. The objectivity of the expert group in the process of assessing the importance of the tactical techniques of attack and defense was established for every variable and expressed as Chronbach's alpha. The condensed expert assessment results were expressed as the arithmetic mean. The principal component analysis was carried out and the Guttman-Kaiser criterion and normalised varimax rotation applied. Analysis of variance was also applied to detect significant factors, communalities for each variable, factor structure matrix and results.

Results

The values of objectivity coefficients (Chronbach's alpha) for the 15 variables of attack phase ranged from 0.87 to 0.99 ($\overline{X}=0.96$), while the values of objectivity coefficients for the 15 variables of defense phase ranged from 0.95 to 0.98 ($\overline{X}=0.97$). Descriptive parameters and results of the Kolmogorov-Smirnov test of the importance grading of the tactical techniques of attack and defense are shown in Tables 4 and 5.

As the significant deviation from the normal distribution was established for 7 ot the total of 15 variables in the phase of attack, correlation and factor analyses

TABLE 1
ATTACK AND DEFENSE FOOTBALL TACTICAL ELEMENTS

1–7 Ground kicks with the: instep center, outside of the instep, inside of the instep, inside of the foot, outside of the foot, ball of the foot, heel (heel kick).

8–12 Air-borne kicks volley and scissors kicks – forward and side volley kicks, forward and side scissors kicks, bicycle kicks (above the head).

13, 14 Bounced-off kicks: half-volleys – forward and side half-volley kicks and punting (drop kick).

15 Kicks with the leg closer to the oncoming ball	16 Kicks with the leg further away from the oncoming ball trajectory
17 Heading the ball (from standing)	18 Heading the ball (from jumping)
19 Heading the ball (from falling/jumping)	20 Short distance goal attacking (up to10 m)
21 Mid-distance goal attacking (10–20 m)	22 Long distance goal attacking (over 20 m)

23–36 Ball manoeuvres with the: inside of the foot dribble, outside of the foot dribble, sole of the foot dribble, back heel dribble, dribbling circles around the opponents, body feint with the outside of the foot, feint shot with the outside of the foot, fake shot with the inside of the foot, fake shot with the sole of the foot, fake shot with the heel back, body fake by moving the leg in front of the ball – outside of the foot dribble, body fake by moving the leg above the ball – outside of the foot dribble, body fake by moving the leg above the ball – inside of the foot dribble, and body fake by moving the leg behind the ball – outside of the foot dribble.

37–39 Dribbling according to the positions of the attacker and his/her defender: dribbling facing the opposing defender, dribbling with the attacker's side or back to the opposing defender

40–42 Dribbling according to the tactical aims in the match: purposeful dribbling (the defender uses it against the attacker when clearing or taking over the ball), positional dribbling (the attacker imposes it on the defender to create a favourable, front position), and attacking dribbling (the attacker imposes it on the defender, mostly in the goal attack zone)

43–46 Advancing the ball with the: instep center, inside of the foot, outside of the foot, sole of the foot.

47–50 Advancing the ball depending on the movement direction: in a straight line, in a semi-circle, in a zig-zag line.

51–53 Advancing the ball depending on the pace: basic pace, average pace, submaximal pace and maximal pace.

54, 55 Advancing the ball depending on the tactical aims in the game: individual action (in combination with dribbling, most often as an introduction to the finishing sub-phase) and favourable position creation (most ofen in the build-up and peak of the attack).

56–59 Openings (getting free): actual opening (in the direct cooperation with a co-player by passing over or/and receiving the ball), deceptive opening (enables a co-player to move into free space), supporting opening (supporting a co-player with the ball when he/she does not establish a contact with the third co-player by passing over the ball), and safety opening (the indirect participation of co-players in the attack until game focus changes).

60–79 Ball control or receiving: shock absorption of parabolas with the: center of the instep, inside of the foot, upper leg, chest and the head; shock absorption of an oncoming ground ball with the inside of the foot; a bounced-off parabola reception and carried out with the sole of the foot, with the inside and the outside of the foot, with the body and the head, maneuvering an oncoming ground ball with the: center of the instep, inside and outside of the foot; manoeuvring a parabola with the: center of the instep, inside and outside of the foot, upper leg, chest and head.

81–87 Ball passing depending on the direction: passing the ball to the oncoming player, passing the ball to a co-player forwards into free space, passing the ball to a co-player backwards into free space, passing the ball to a co-player across the football pitch, reverse ball passes, forward diagonal ball, backward diagonal ball, parallel cross ball

88–90 Ball passing over: short distance (up to 10 m), mid-distance (10m to 30m) and long distance (over 30m).

91–93 Positions' changes with the aim to: pass the ball timely and efficiently create free space for a co-player, destroy the positioning of the opposing defensive players.

94, 95 Marking the opposing players: man-to-man marking and zone defense

96, 97 Obstructions: obstructing opposing players and goal keeper.

98, 99 Takeover: active and passive takeover (with and without the change of position in the basic players lineup).

100–104 Clearing the ball: kicking out an oncoming ground ball in front of the opposing player, kicking out a parabola in front of theopposing player, kicking out the bounced-off ball in front of the opposing player, heading out a parabola and heading out the bounced-off ball in front of the opposing player.

105–107 Ball takeover depending on the moment of takeover: before it is obtained by the opposing attacker (tackle the ball in front of the opponent), when the opposing attacker is taking hold of it (tackle the ball in front of the opponent) and after it is obtained by an opposing attacker.

108–117 Ball takeover depending on the way it is done: basic takeover – frontal relationship between the defender and attacker, basic takeover – sideways relationship betwen the defender and attacker, basic takeover – the defender is behind the attacker. Ball takeover by pushing out the opposing player from the lead (by shouldering), frontal slide tackle, sideways slide tackle, slide tackle from behind oncoming ground ball takeover by tackling the ball in front of the opposing player, a parabaola takeover by tackling the ball in front of the opposing player, bounced-off ball takoever by tackling it in front of the opposing player.

TABLE 2
ATTRIBUTES OF THE GAME OF FOOTBALL

Positions of players in the game:

POF – positions of forwards

POCM – positions of centre midfielders

POWM – positions of wing midfielders

POIF – positions of inside forwards

POWM – positions of wide midfielders

POFDP – positions of front defensive players

POFCB – positions of front centre-backs

POFW – positions of front wingbacks

POFB – positions of full-backs

POBW – positions of back (rear) wingbacks

Sub-phases of the game:

FSP – finishing sub-phase

TADLBF – transition from attack to defense after losing the ball in the finishing sub-phase

PASP – point of the attack sub-phase

TADLBA – transition from attack to defense after losing the ball at the point of attack

ABSP – attack build-up sub-phase

TADLBAB – transition from attack to defense after losing the ball in the attack build-up

WDS – wide defense sub-phase

TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone

MDS – midfield defense sub-phase

TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone

CDS – core defense sub-phase

TDABTWC – transition from defense to attack after the ball takoever within the core zone

Attack types:

PAC – progressive attack: continuous attack

PACA – progressive attack: counter-attack

CA – combinedattack

NPA – non-progresive attack

Defense types:

CD – combined defense

CDZ – core zone defense

MD – midfield defense

WZD – wide zone defense

TABLE 3
SUM TOTAL VARIABLES IN THE PHASES OF DEFENSE AND ATTACK

Sum total variables for attack:

TPPA – total of the positions of players in (POF, POCM, POWM, POIF, POWM)

TPPSPA – total of the sub-phases of attack (FSP, PASP, ABSP, TDABTWD, TDABTMD, TDABTWC)

TAT – total of the attack types (PAC, PACA, CA, NPA)

TPA – total properties of play in attack (attack variables – total)

Sum total variables for defense

TPPD – total according to the positions of defense players (POFDP, POFCB, POFW, POFB, POBW)

TPPDSP – total according to the defense sub-phases (WDS, MDS, CDS, TADLBF, TADLBA, TADLBAB)

TTD – total according to the types (styles) of defense (CD, CDZ, MD, WZD)

TPD – total according to the game properties in defense (total of defense variables)

The correlation and factor analyses were carried out on the basis of Spearman's rank correlation (Table 9) and Pearson's correlation coefficient after the identification of the significant deviation from the normal distribution of 3 out of the total of 15 variables in the phase of defense. Factor analysis of properties or variables of defense (principal component analysis), carried out according to the Guttman-Kaiser criterion, produced a factor correlation matrix as a part of an exploratory strategy (Table 10). Table 11 shows the communalities of the basic variables estimated on the basis of isolated or extracted factors that explained the quantity of information in each variable, which variables were used to affect the identification of the obtained factors.

Discussion

The coefficients for the inter-raters' objectivity indicated a high degree of expert agreement on all the properties of the phases of attack and defense. High objectivity coefficients for each variable also indicated an insignificant presence of accidental error in the expert estimations. Thus, all the assessed variables describing the phases of attack and defense are comprised in further analyses.

Latent structure of attack

The average assessment values of tactical techniques in the sum total variables describing the phase of attack confirmed the high complexity of soccer in this phase. Smaller complexity of properties POWM, ABSP, TDABTWC and PACA can be ascribed to the fact that players in the positions of inside forwards and centre forwards in the sub-phase of the attack build-up or during the transition from the phase of defense to that of attack, following the ball take-over in the core defense zone, rarely use complex tactical techniques such as dribbling or fakes, ball

were carried out on the basis of Spearman's rank correlation and Pearson's correlation coefficient (Table 6). Factor analysis of the properties or variables of attack (principal component analysis), carried out according to the Guttman-Kaiser criterion, produced a factor correlation matrix as a part of an exploratory strategy (Table 7). Table 8 shows the communalities of the basic variables estimated on the basis of isolated or extracted factors that explained the quantity of information in each variable that they used to affect the identification of the obtained factors.

TABLE 4

DESCRIPTIVE PARAMETERS AND RESULTS OF KOLMOGOROV-SMIRNOV TEST OF THE IMPORTANCE GRADES (WEIGHTS) OF ATTACK
TACTICS (N=93)

Variable	$\overline{X}$	Minimum	Maximum	Range	SD	Skewness	Kurtosis	max D	K-S p
POF	4.174	2.400	5.000	2.600	0.611	–0.698	0.192	0.108	p>.20
POCM	4.291	2.400	5.000	2.600	0.742	–1.195	0.285	0.213	p<.01*
POWM	4.044	1.700	5.000	3.300	0.846	–1.001	0.335	0.154	p<.05*
POIF	3.162	1.200	5.000	3.800	1.156	0.001	–1.212	0.099	p>.20
POWM	2.998	1.100	5.000	3.900	1.236	–0.027	–1.449	0.124	p<.15
FSP	4.012	1.500	5.000	3.500	0.933	–1.083	0.370	0.148	p<.05*
PASP	3.196	0.000	5.000	5.000	1.374	–0.519	–0.672	0.112	p<.20
ABSP	2.174	0.000	5.000	5.000	1.407	0.632	–0.716	0.157	p<.05*
TDABTWD	3.995	0.400	5.000	4.600	1.112	–1.348	1.017	0.200	p<.01*
TDABTMD	3.661	0.000	5.000	5.000	1.357	–1.247	0.555	0.165	p<.05*
TDABTWC	2.603	0.000	5.000	5.000	1.468	0.133	–1.131	0.108	p>.20
PAC	4.025	1.400	5.000	3.600	0.796	–0.962	0.651	0.122	p<.15
PACA	2.669	0.000	5.000	5.000	1.178	–0.023	–0.676	0.096	p>.20
CA	3.934	1.100	5.000	3.900	1.002	–0.858	–0.289	0.165	p<.05*
NPA	3.490	0.700	5.000	4.300	1.194	–0.665	–0.762	0.129	p<.10
TPPA	3.734	1.980	4.960	2.980	0.733	–0.546	–0.287	0.082	p>.20
TPPSPA	3.273	0.700	4.950	4.250	1.055	–0.316	–0.832	0.076	p>.20
TAT	3.530	1.100	4.725	3.625	0.806	–0.632	–0.072	0.074	p>.20
TPA	3.495	1.233	4.860	3.627	0.818	–0.424	–0.349	0.102	p>.20

*Distribution of the variable departs from the normal distribution
KS-test$_{0.05}$=0.137

TABLE 5

DESCRIPTIVE PARAMETERS AND RESULTS OF KOLMOGOROV-SMIRNOV TEST OF THE IMPORTANCE GRADES (WEIGHTS) OF
DEFENSE TACTICS (N=24)

Variable	$\overline{X}$	Minimum	Maximum	Range	SD	Skewness	Kurtosis	max D	K-S p
POFDP	2.325	0.900	4.900	4.000	1.259	0.964	–0.168	0.185	p>.20
POFCB	3.600	1.300	5.000	3.700	1.157	–0.941	–0.251	0.201	p>.20
POFW	3.779	1.400	4.700	3.300	0.804	–1.377	2.193	0.126	p>.20
POFB	4.371	0.600	5.000	4.400	0.991	–2.684	8.730	0.297	p <.05*
POBW	4.275	0.600	5.000	4.400	0.923	–3.072	11.166	0.262	p<.10
TADLBF	2.233	1.100	4.500	3.400	0.948	1.050	0.580	0.176	p>.20
TADLBA	3.558	1.300	4.800	3.500	1.147	–0.777	–0.892	0.233	p<.15
TADLBAB	4.213	0.900	5.000	4.100	0.934	–2.423	6.404	0.285	p <.05*
WDS	2.471	0.700	5.000	4.300	1.137	0.811	0.287	0.145	p>.20
MDS	3.788	0.500	5.000	4.500	1.183	–1.479	1.547	0.213	p<.20
CDS	4.142	0.000	5.000	5.000	1.110	–2.565	8.046	0.220	p<.20
CD	4.117	1.800	5.000	3.200	0.860	–1.251	0.915	0.256	p<.10
CDZ	4.038	0.000	5.000	5.000	1.203	–2.025	4.509	0.285	p <.05*
MD	3.842	0.800	5.000	4.200	1.246	–1.002	0.069	0.213	p<.20
WZD	3.621	1.400	4.900	3.500	1.014	–0.525	–0.677	0.140	p>.20
TPPD	3.670	1.800	4.700	2.900	0.744	–1.136	0.799	0.193	p>.20
TPPDSP	3.401	1.500	4.350	2.850	0.814	–1.087	0.314	0.207	p>.20
TTD	3.904	1.000	4.925	3.925	1.000	–1.422	1.837	0.217	p<.20
TPD	3.625	1.467	4.467	3.000	0.808	–1.407	1.209	0.222	p<.15

* Distribution of the variable departs from the normal distribution
KS-test$_{0.05}$=0.269

TABLE 6
PEARSON'S AND SPEARMAN'S COEFFICIENTS OF CORRELATION AMONG THE VARIABLES OF ATTACK TACTICS IMPORTANCE GRADES

	POF	POCM	POWM	POIF	POWM	FSP	PASP	ABSP	TDABTWD	TDABTMD	TDABTWC	PAC	PACA	CA	NPA
POF	1.00	0.70	0.61	0.31	0.10	0.75	0.40	0.24	0.68	0.41	0.15	0.58	0.24	0.69	0.41
POCM	0.74	1.00	0.68	0.58	0.33	0.77	0.69	0.47	0.70	0.67	0.45	0.65	0.49	0.80	0.59
POWM	0.68	0.78	1.00	0.50	0.42	0.74	0.41	0.28	0.65	0.52	0.30	0.65	0.46	0.70	0.40
POIF	0.33	0.58	0.54	1.00	0.81	0.50	0.67	0.68	0.31	0.47	0.68	0.55	0.75	0.59	0.45
POWM	0.13	0.36	0.43	0.81	1.00	0.28	0.44	0.51	0.05	0.23	0.60	0.30	0.57	0.32	0.21
FSP	0.76	0.83	0.82	0.58	0.35	1.00	0.59	0.38	0.79	0.58	0.34	0.78	0.55	0.84	0.44
PASP	0.35	0.59	0.43	0.64	0.39	0.54	1.00	0.80	0.59	0.83	0.78	0.54	0.46	0.69	0.76
ABSP	0.19	0.41	0.32	0.69	0.57	0.37	0.76	1.00	0.42	0.68	0.89	0.39	0.40	0.52	0.76
TDABTWD	0.62	0.70	0.67	0.34	0.08	0.71	0.55	0.40	1.00	0.71	0.35	0.70	0.29	0.81	0.59
TDABTMD	0.34	0.52	0.47	0.41	0.15	0.48	0.84	0.63	0.68	1.00	0.66	0.57	0.29	0.68	0.77
TDABTWC	0.15	0.41	0.33	0.67	0.58	0.36	0.78	0.90	0.36	0.65	1.00	0.36	0.38	0.49	0.74
PAC	0.60	0.72	0.74	0.57	0.33	0.80	0.50	0.37	0.64	0.50	0.35	1.00	0.59	0.79	0.48
PACA	0.21	0.45	0.44	0.72	0.52	0.52	0.41	0.40	0.21	0.23	0.37	0.51	1.00	0.47	0.17
CA	0.67	0.81	0.79	0.62	0.37	0.87	0.61	0.49	0.75	0.55	0.48	0.82	0.45	1.00	0.58
NPA	0.36	0.53	0.42	0.41	0.15	0.45	0.77	0.70	0.64	0.82	0.72	0.46	0.16	0.53	1.00

*Values above the diagonal line are Spearman correlation coefficients; those below the line are Pearson correlation coefficients.

advancing, positions changes, fake openings, etc.[6] The high average assessment value of the importance of tactical elements (POF, POCM, POWM, FSP, TDABTWD, PAC i CA) in the realization of game properties was expected since efficient solution of demanding motor situations necessitates the use and combination of a large number of tactical techniques. The mentioned game segments are marked with individual actions of strikers who aim to create favourable situations (opportunities) and numeric ratios (ball advancings and fakes), but the game segments are also marked by complex and cooperative play of attackers (openings, positions changes, various types of ball passes and ball receptions).

The connection among the players in the phase of attack is not surprising since the positive correlation between the playing positions is obvious (the positions being closely connected due to the features of the soccer pitch). The players in one team are also connected by the relations of cooperation in typical situations involving two or three attackers, which confirms the importance of the finishing sub-phase of the game[6]. The ABSP and TDABTWC variables are also highly associated, which

only confirms the soccer practice where the transition from the defensive to the attacking actions in front of one's goal is considered the most sensitive (the riskiest) type of tactical techniques of an individual player and the team as a whole. There is also an obvious association be-

TABLE 7
EIGENVALUES AND THE PROPORTION OF THE EXPLAINED VARIANCE BY THE PRINCIPAL COMPONENTS FOR THE SPACE OF ATTACK TACTICS IMPORTANCE GRADES

Component	Eigenvalues (λ)	% of total variance (λ %)	Cumulative % of total variance (λ cum %)
1	8.500	56.6	56.6
2	2.239	14.9	71.5
3	1.733	11.6	83.2

TABLE 8
FACTOR STRUCTURE MATRIX FOR THE VARIABLES OF ATTACK TACTICS IMPORTANCE GRADES, VARIANCE OF FACTORS (EXPL. VAR), PROPORTION OF FACTORS' VARIANCE IN THE TOTAL VARIANCE (PRP. TOTL) AND COMMUNALITIES OF THE VARIABLES

Variable	Factor 1	Factor 2	Factor 3	Communality
POF	0.853	0.079	0.003	0.73
POCM	0.821	0.287	0.259	0.82
POWM	0.837	0.150	0.294	0.81
POIF	0.330	0.344	0.827	0.91
POWM	0.089	0.161	0.889	0.86
FSP	0.883	0.192	0.288	0.90
PASP	0.315	0.819	0.295	0.86
ABSP	0.082	0.790	0.495	0.88
TDABTWD	0.763	0.474	–0.107	0.80
TDABTMD	0.378	0.844	–0.012	0.85
TDABTWC	0.055	0.812	0.489	0.90
PAC	0.790	0.213	0.300	0.76
PACA	0.322	0.051	0.746	0.66
CA	0.814	0.336	0.291	0.86
NPA	0.336	0.876	–0.018	0.88
Expl.Var	5.333	4.111	3.027	
Prp.Totl	0.356	0.274	0.202	

TABLE 9

PEARSON'S AND SPEARMAN'S COEFFICIENTS OF CORRELATION AMONG THE VARIABLES OF THE DEFENSE TACTICS IMPORTANCE GRADES

	POFDP	POFCB	POFW	POFB	POBW	TADLBF	TADLBA	TADLBAB	WDS	MDS	CDS	CD	CDZ	MD	WZD
POFDP	1.00	0.48	0.36	–0.18	0.23	0.87	0.32	0.20	0.61	0.30	–0.27	0.06	–0.22	0.29	0.39
POFCB	0.31	1.00	0.75	0.45	0.79	0.54	0.82	0.54	0.72	0.82	0.34	0.64	0.45	0.79	0.67
POFW	0.08	0.82	1.00	0.38	0.71	0.43	0.58	0.47	0.58	0.51	0.34	0.52	0.41	0.63	0.48
POFB	–0.38	0.67	0.75	1.00	0.70	–0.05	0.70	0.38	0.13	0.57	0.76	0.72	0.78	0.69	0.54
POBW	–0.20	0.72	0.86	0.94	1.00	0.32	0.86	0.32	0.45	0.77	0.47	0.77	0.69	0.87	0.79
TADLBF	0.88	0.43	0.30	–0.14	0.05	1.00	0.48	0.22	0.57	0.40	–0.25	0.09	–0.16	0.40	0.45
TADLBA	0.25	0.92	0.71	0.67	0.72	0.43	1.00	0.45	0.41	0.87	0.47	0.77	0.62	0.94	0.87
TADLBAB	–0.12	0.76	0.78	0.87	0.85	0.08	0.71	1.00	0.33	0.51	0.38	0.43	0.36	0.47	0.40
WDS	0.74	0.63	0.39	0.02	0.14	0.71	0.44	0.22	1.00	0.40	0.12	0.32	0.16	0.35	0.27
MDS	0.06	0.91	0.79	0.83	0.87	0.22	0.92	0.87	0.35	1.00	0.48	0.78	0.50	0.90	0.86
CDS	–0.38	0.65	0.75	0.95	0.91	–0.19	0.63	0.87	0.02	0.84	1.00	0.72	0.81	0.53	0.42
CD	–0.17	0.80	0.76	0.90	0.86	–0.01	0.77	0.79	0.22	0.89	0.87	1.00	0.75	0.83	0.68
CDZ	–0.48	0.59	0.66	0.95	0.87	–0.28	0.61	0.77	–0.09	0.75	0.90	0.87	1.00	0.64	0.48
MD	0.09	0.89	0.77	0.79	0.83	0.25	0.94	0.79	0.30	0.96	0.75	0.88	0.76	1.00	0.88
WZD	0.16	0.79	0.66	0.68	0.77	0.26	0.90	0.69	0.23	0.91	0.68	0.78	0.63	0.93	1.00

*Values above the diagonal line are Spearman correlation coefficients; those below the line are Pearson correlation coefficients.

tween the type of attack (continuous and combined) and the midfielders who manage, that is, who are responsible for their own team's play organisation, actions, changes of game focus and attack pace. The strikers' primary task, on the other hand, is to ensure a positive outcome of the game; the withdrawn strikers' job is to offer midfielders support and to ensure the attack. The high correlation between the withdrawn strikers and the counter-attack is logical. Namely, after the ball possession in the core defense zone has been won, the centre-backs' role transforms into the withdrawn strikers's role manifested as their engagement in long vertical or diagonal passes to the forwards[6]. The determined high values of communalities indicate an important system of variables which provided the most significant contribution to the explication of the attack phase latent structure variables of soccer.

The first latent dimension explains 35.6% of the total variance of attack tactical elements and, it is associated with most manifest variables (FSP, POF, POWM, POCM, CA, PAC and TDABTWD). The finishing sub-phase of the game provides the most significant contribution to the explanation of the first latent dimension as it represented the realisation of the basic mission of soccer – to

score a goal. From the theoretical point of view, the finishing sub-phase is of crucial importance. In other words, the other sub-phases act as its support in the phase of attack. The variable of the finishing sub-phase comprises the remaining variables with the significant projections

TABLE 11

FACTOR STRUCTURE MATRIX FOR THE VARIABLES OF DEFENSE TACTICS IMPORTANCE GRADES, VARIANCE OF FACTORS (EXPL. VAR), PROPORTION OF FACTORS' VARIANCE IN THE TOTAL VARIANCE (PRP. TOTL) AND COMMUNALITIES OF THE VARIABLES

Variable	Factor 1	Factor 2	Communality
POFDP	–0.162	0.960	0.95
POFCB	0.837	0.485	0.94
POFW	0.838	0.239	0.76
POFB	0.947	–0.233	0.95
POBW	0.949	–0.053	0.90
TADLBF	0.041	0.931	0.87
TADLBA	0.838	0.426	0.88
TADLBAB	0.900	0.021	0.81
WDS	0.193	0.843	0.75
MDS	0.954	0.221	0.96
CDS	0.929	–0.246	0.92
CD	0.944	–0.015	0.89
CDZ	0.899	–0.348	0.93
MD	0.927	0.238	0.97
WZD	0.841	0.264	0.78
Expl.Var	9.816	3.387	
Prp.Totl	0.654	0.226	

TABLE 10

EIGENVALUES AND THE PROPORTION OF THE EXPLAINED VARIANCE BY THE PRINCIPAL COMPONENTS FOR THE SPACE OF DEFENSE TACTICS IMPORTANCE GRADES

Component	Eigenvalues (λ)	% of total variance (λ %)	Cumulative % of total variance (λ cum %)
1	9.928	66.2	66.2
2	3.275	21.8	88.0

on the first latent dimensions. This is the reason why it provides the most information[6]. The structuring process of the first latent dimension is marked by the hierarchical organisation: the second level comprises: the positions of players who are marking the game in the finishing part due to their characteristics and roles. The third level comprises the two basic types of attack characterised by pace changes in the sub-phases of the game, while the fourth level of the first latent dimension is represented by the variable of transitions from the phase of defense to the phase of attack upon ball possession in the wide defense zone. This is in concordance with Hughes's research[12] which established that the players in the goal area have to manifest a perfect technique of ball possession, ball handling (advancing, dribbling,) fake ball manoeuvres, headers and kicks. or foot. The attack phase starts at the moment of ball takeover, which can happen on different parts of the soccer pitch. Basic styles of play of top soccer teams in the attack phase (combined and progressive, continuous attack) rely on a greater number of attempts to finish the attack by scoring a goal. Due to the relative approximity of the opposing goal and the basic lineup of team players, the front forwards and midfielders are first to enter into in the finishing sub-phase, before all other teammates. Top soccer teams perform 50 and more finishing attempts in a single game, out of which there are 15–20 scoring attempt[4,17]. When the team loses the ball possession in the finishing zone (scoring danger zone), wide defensive zone is immediately organised with the aim to regain the ball possession already in the opposing team's half of the soccer pitch[6,17]. The first latent dimension is connected with the largest number of the variables relating to the finishing sub--phase of attack (with forwards and midfielders; most common types of attack in the attempt to end the finishing sub-phase and transition from defense to attack upon the ball takeover in the wide defensive zone). On the basis of the mentioned properties defining the latent content of the first factor, this dimension can be named the »efficiency factor of the finishing sub-phase of soccer«.

The second latent dimension explains 27.4% of the total variance and is determined, to the greatest extent, by the positive projections of the five play attributes (NPA, TDABTMD, PASP, TDABTWC and ABSP). This latent dimension is strongly influenced by the variable of non--progressive attack, which is applied as a form of lasting ball possession (the ball is played around) and in game intervals when a partial recovery of the team is needed during the game. Most frequently it is used to keep the positive score, or as a type of preparation for both the progressive and combined attacks as another attempt in the finishing sub-phase of the game. This is in concordance with the research carried out by Hughes and Churchill[17], who established that the most successful teams have the ball in their possession for a longer time while creating the finishing sub-phase of attack. This is supported by the research carried out by Ensum et al.[14] who found that quality and type of ball possession can influence the ratio between shots at goal attempted and

the goals scored. The second latent dimension is also characterised by the hierarchical organisation: the second level belongs to the properties of transition from the phase of defense to the phase of attack upon the ball takeover in miedfield defensive zone, properties of the peak of attack sub-phase, properties of transition from the phase of attack upon the ball takeover in the core defensive zone and properties of the sub-phase of the attack build-up. The transition to the phase of attack upon the ball takeover spatially overlaps with the soccer pitch zones or the sub-phases of attack, which only further confirms the correlation of the attack properties in determining this latent dimension. Taking into account the defining variables, the second latent dimension is also known as the »efficiency factor in ball possession«[19].

The third latent dimension explains 20.2% of the total valid variance and is determined to the largest extent by the positive projections of five properties or variables (POWM, POIF, PACA, ABSP and TDABTWC). It is mostly affected by the variables of the positions of wide midfielders, inside forwards and progressive attack – counter-attack. A lesser contribution to this latent dimension is provided by the variables of the sub-phases of attack build-up and transition from the phase of defense to the phase of attack upon the ball takeover in the core defensive zone. However, this is due to the obvious correlation of the variables that characterise the actions and moves in the organisation of the counter-attack. If the seemingly subordinated soccer team coordinates a transition upon the ball takeover in the core defensive zone and carry out the counter-attack efficiently, a simple combination can result in the realisation of the finishing phase of attack, that is, in scoring. Wide midfielders and inside forwards play important roles in the counter-attack as they direct the ball in attack upon its takeover in the core defensive zone, either directly or indirectly, with a help of a teamate. The ball is directed as long, precise, vertical or diagonal passes into the finishing sub-phase of attack (scoring danger zone) to the forwards and midfielders[19]. In this way play in the key part of attack is skipped over and the counter-attack is the fastest type of attack. As it has already been pointed out, counter-attack is a justified and efficient technique in certain intervals of the game, but it is not tactically acceptable as the basic type of play in the sub-phase of team attack. According to the variables defining the third latent dimension, it can be named the »efficiency factor of the counter-attack«.

Latent structure of defense

In spite of the high average assessment value describing play in the phase of defense, and due to less complex and fewer tactical techniques applied in it (N=24), the phase of defense is less complex than the phase of attack. Smaller complexity of certain attributes (POFDP, TADLBF and WDS) was expected taking into consideration that their realisation necessitated simplicity, that is, use of a few, technically simpler, elements with the aim of obstructing the return of the opposing player into the midfield defensive zone, together with only rare attem-

pts of direct taking over the ball or of clearing it away. Bigger complexity of other attributes (POFCB, POFW, TADLBA, MDS, MD and WZD) was also expected since their realisation necessitated a larger number of more complex tactical techniques of defense, but their use is somewhat less important compared with the tactical techniques used directly in front of the team's goal. High average importance assessment value of tactical techniques in the realisation of the game attributes (POFB, POBW, TADLBAB, CDS, CD and CDZ) was expected as the task in these game segments is complex. An efficient resolution of demanding situations requires the use and combination of a larger number of defensive tactical techniques.

High correlation of the variables covering the playing positions in the phase of defense according to their basic lineup was expected taking into consideration the most important tasks in the play of rear centre-backs and wingbacks. However, the correlation between the front centre-backs and wingbacks indicates their defensive task. High correlation coefficients between the sub-phases of the game and the positions of defense players result from the overlapping of frequencies of defensive tasks with the zones of defense players' activity. The mentioned correlations indicate the existence of »flat (withdrawn on the own third) defense formation«, assistance, doubling, and takeover in defense actions[6]. The correlation between the combined type of defense applied in modern soccer and the positions of defense players confirm the previously mentioned opinions on the role of various defense lines in a team. High values of correlation coefficients in the variables referring to the correlation between the positions of defense players and the transition from attack to defense upon the ball loss indicate a trend in modern soccer: the primary task in that moment of the closest line of defense players and the team as a whole is to regain the ball as soon as possible in their possession[6]. The obtained negative correlation values indicates that front defense players have specific defense tasks of obstructing the opposing forwards, which is manifested far from their own goal, but is extremely important in top soccer.

The communalities have high values which indicate very high communal variances of the manifest variables with the one or more extracted factors. The determined high values of the communalities also indicate the pregnant system of variables which contributed greatly to the explication of the latent structure of the defense phase variables.

First latent dimension explains 65.4% of the total valid variance and is determined by the high positive projections of the 12 variables: (MDS, CDS, POBW, CD, TADLBA, CDZ, POFCB, POFW, POFB, TADLBAB, MD, WZD). The most significant contribution to the explication of the first latent dimension is provided by the variables of the sub-phase of midfield defense, position of the rear centre-backs, position of the rear wingbacks and the combined defense. Top soccer teams apply combined defense often. Depending on the attack actions of the op-

posing team, space and time factors, some defense players apply zone defense, while the others apply man-to-man defense, which is mostly attempted in the midfield, i. e. already in the opposing team's half of the pitch[20]. Such distribution serves the function of keeping the opposing attack players at a distance from one's own goal. At the same time, more players in the basic distribution engage in the process of ball taking over, transition from defense to attack and the finishing sub-phase (»flatness« of the defense formation, i. e. the proximity of defense teammates distributed vertically and horizontally on the pitch). The variables of the position of the front centre-backs and the position of the front wingbacks also significantly define the first latent dimension. Combined defense is applied in the same way in the sub-phase of the core defense zone (scoring danger zone). The next level in the structure of the first latent dimension comprises a transition from the phase of attack to the phase of defense upon the ball possession loss in the attack build-up area and a transition from the phase of attack to the phase of defense upon the ball possession loss in the peak of the attack area[6]. In the mentioned situations the defenders aim at preventing the opposing team's counter-attack or, if possible, slowing down the attack by timely and efficient distribution, marking, ball clearing and attempts to take the ball possession over[6]. The first principal component is associated with every variable relating to the basic type of defense in the midfield and close field zone. On the basis of the attributes defining the latent content of the first factor, this dimension can also be called the »efficiency factor of combined defense«.

The second latent dimension explains 22.6% of the total variance and is determined by the both the positive and negative projections of the properties or variables. The high positive projections resulted from the variables of the position of front defense players (POFDP), transition from the phase of attack to the phase of defense upon the ball possession loss in the finishing zone of attack (TADLBF) and the sub-phase of wide defense (WDS). The negative projections on the second latent dimension were created by the game attributes in the phase of defense: position of rear centre-backs (POFB) and rear wingbacks (POBW), and the sub-phase of core defense (CDS). The two opposing levels can be considered as logical knowing the structure of soccer. The first, positive, level describes 'the defense in wide zone (within 30 m from the opposing team's goal), where the front defenders are dominant in their lines of movement and obstruction of the opposing players. At the same time the remaining defenders in the team have to form the combined defense in the midfield. Attempts to take the ball directly are carried out in the lane to which the front defenders »channel the passage« of the ball during the attack of the opposing team's build-up and in the situations where defenders outnumber the opponents. In this segment of defense a »flat defense formation« is necessary, which is why the rear centre-backs and wingbacks have to be in the midfield defense zone as well to support their teammates[6]. That is why it was expected to find their negative

projection on the second latent dimension. In the sub-phase of core defense the rear defenders should not fall behind in front of their own goal while the front defenders obstruct the attack build-up of the opposing team. If this is done in time, an efficient ball takover can happen already in the midfield defese zone, or there is more chance for corrective actions in the phase of defense taking place at a distance from own's goal[21]. The second latent dimension is defined by the variables that determine the play of the front defense players in the wide defense zone so it can be defined as »the factor of obstruction and direction of the opposing team's attack build-up«.

Conclusion

The obtained results lead to several conclusions that have broadened the kinesiological body of knowledge on soccer. A large number of entities (tactical techniques) in the phases of attack and defense can be divided into a smaller number of homogeneous and interdependent factors, defined as:

– the finishing sub-phase of attack;

– efficiency factor of ball possession;
– efficiency factor of counter-attack;
– efficiency factor of combined defense;
– factor of obstrucion and direction of the opposing team's attack build-up.

The research has partly solved the problem of hypothetical structure of tactical techniques of soccer recognised by experts, who also established entities according to the phases and sub-phases of the game, positions of attack and defense players and types (styles) of play in attack and defense. In other words, if it is known which structures of movement mostly influence efficient performance on a certain playing position, and then performance in the sub-phases and styles of play, it is possible to create training operators that will specifically influence the formation of the most important motor abilities and skills in soccer. The established latent structure of soccer attributes gives a clearer image of what precedes soccer actions and what allows the process of planning training programs and development of technical and tactical knowhow with the aim of improving invididual, team lines and team tactics.

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LATENTNA STRUKTURA NOGOMETNE IGRE U FAZI NAPADA I OBRANE

S A Ž E T A K

S ciljem utvrđivanja latentne strukture taktičkih sredstava u fazi napada i obrane u nogometu definirano je 117 taktičkih sredstava nogometne igre čija je važnost procijenjena na 30 varijabli koje označavaju temeljne segmente nogometne igre. Uzorak entiteta u ovom istraživanju predstavljaju 93 napadačka i 24 obrambena taktička sredstva koja su opisana sa 15 varijabli faze napada i 15 varijabli faze obrane. Za određivanje karakteristika entiteta kroz ukupno 30 varijabli, korišteno je ekspertno znanje desetorice kompetentnih nogometnih stručnjaka. Eksperti su ocjenama 0–5 na temelju vlastitih spoznaja procijenili utjecaj svakog entiteta (taktičkog sredstva) na pojedine varijable koje opisuju nogometnu igru u fazi napada i fazi obrane. Na temelju vrijednosti koeficijenata objektivnosti utvrđen je visok stupanj slaganja mišljenja eksperata oko predmeta u svim atributima napada i obrane. Faktorskom analizom pod komponentnim modelom uz Guttman – Kaiserov kriterij dobiveno je ukupno pet značajnih latentnih dimenzija: faktor efikasnosti završnice napada, faktor uspješnosti posjeda lopte, faktor efikasnosti kontranapada, faktor uspješnosti kombinirane obrane, faktor ometanja i »usmjeravanja« pripreme protivničkog napada. Istraživanjem je djelomično riješen problem hipotetske strukture taktičkih sredstava nogometne igre prema fazama i podfazama igre, pozicijama napadača i obrambenih igrača te vrstama (načinima) igre u napadu i obrani. Ukoliko je poznato koje strukture kretanja najviše utječu na efikasnost neke igračke pozicije, zatim na uspješnost u podfazama i načinima igre, moguće je kreirati trenažne operatore kojima će se ciljano utjecati na formiranje najvažnijih motoričkih znanja u nogometu.