4. COMPUTER SCIENCE AND MATCH ANALYSIS IN ASSOCIATION FOOTBALL

O-020 Comparison of activity profile during matches in Danish and Swedish premier league and matches in Nordic royal league tournament

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OBJECTIVE The first Nordic Royal League tournament was played in 2004/2005. The top-4 teams from Denmark, Sweden and Norway participated in the tournament. The proclaimed goal of this tournament was to give the best Nordic teams more off-season matches at a high standard. The aims of the present study were to compare the physical match performance in the Danish Premier League (DPL) and Swedish Premier League (SPL) and to compare the match activities in the national leagues (NL) with the Royal League Tournament (RL).

METHODS 23 players from DPL and 23 players from SPL were filmed individually by camcorders for later obtainment of computerized time-motion analyses (Mohr et al., 2003). Players in the two groups were matched according to positional role in the team as well as representation of top-, middle- and bottom-teams. 14 of those players were also filmed in RL matches. Differences between DPL and SPL were evaluated by Student's unpaired t-test and differences between NL and RL by Student's paired t-test.

RESULTS Total distance covered was higher ($p < 0.05$) in DPL than SPL (10.80±0.17 vs. 10.15±0.21 km), but high intensity running (HIR; 2.13±0.10 vs. 2.03±0.12 km) and sprinting (SPR; 0.47±0.03 vs. 0.44±0.03 km) over 90-min was not different. HIR (0.21±0.01 vs. 0.21±0.01 km) and SPR (72±4 vs. 67±5 m) in the most intense 5-min period were also similar. No difference was observed between RL and NL games ($p > 0.5$).

DISCUSSION The physical performance in the Royal League tournament was similar to the national leagues and was considered to be a good off-season supplement. Danish Premier League players covered a greater total distance than players in the Swedish Premier League, which seems to be related to more offensive running by the defensive Danish League players. However, no differences were observed in high intensity running and sprinting between the Danish and Swedish league.

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Mohr et al. (2003) *J Sports Sci* **21**, 519-528.

KEY WORDS Total distance covered, high intensity running, sprinting, tackles, headers.

O-021 The effect of a succession of matches on the activity profiles of professional soccer players

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OBJECTIVE In modern day soccer, the capacity to recover from intense training or matches is often considered to be an important determinant of subsequent performance. Incomplete recovery may be a regular occurrence where UK elite soccer players repeatedly perform over a short time frame, often 3 times a week. This may have implications with regards to fatigue, overreaching, injury, preparation and activity profiles. Research to date has concentrated on the influence of fatigue within matches (Di Salvo et al 2006) and fatigue over different phases of the season (Mohr et al 2003). The aim of this study was to investigate activity profiles of professional UK-based Premiership/Championship soccer players competing over an intense period of matches.

METHODS This study incorporated time motion analysis data captured via the computerised ProZone system (3) ProZone Group Ltd. This system has been independently validated to verify the capture process and subsequent accuracy of data (Di Salvo et al., 2006). Twenty-two teams, who played 3 matches across 5 days were assessed and activity pro-

files were collated to evaluate each player's match contribution. Data Analysed Via One Way ANOVA & Post Hoc Paired T test.

RESULTS High intensity (HI) activity profiles declined with respect to the distance covered in possession of the ball (376.8± 259.2 Vs 273.6±211 m, $p < 0.05$) and when the ball was out of play (82.2±40.9 Vs 53.1±38.1 m $p < 0.05$) for matches 1 & 3 respectively. Overall distance covered did not change (Table 1) between the 3 matches whereas average recovery between HI activity bouts did (52.1±13.6 Vs 62.3±22.6 sec. $p < 0.05$).

Table 1. Mean values (SD) for each variable for matches 1-3 over 5 days

Variable	Match 1	Match 2	Match 3
Distance (m)			
Total Distance	10695.9 (882.5)	10789.9 (809.2)	10492. (1001.9)
HI Distance	889.2 (263)	858.5 (300.8)	768.8 (260.8)
Sprint Distance	233.3 (89.6)	214.6 (115.2)	190.6 (76)
High Speed Run	655.9 (186.1)	643.9 (197.2)	578.3 (206.8)
Run Distance	1639.7 (311.1)	1652.1 (335.4)	1613.6 (367.2)
Jog Distance	4237.3 (531.6)	4415.8 (497.8)	4301.7 (587.9)
Walk Distance	3902.8 (195.2)**	3839.1 (194.7)	3785.1 (297.6)**
HI with possession	376.8 (259.2)*	299.1 (234.9)	273.6 (211)*
HI Without Possession	430.3 (134.6)	500.4 (171.7)	442.1 (145.8)
HI Distance Ball Out Of Play	82.2 (40.9)*	59 (33.6)	53.1 (38.1)*
Frequency (number)			
Total No. HI Activities	113.6 (26.6)	114.1 (36.4)	99.1 (35.9)
Sprints	34 (12.3)	34.1 (15.9)	27.1 (12.1)
HSR	126.5 (28.9)	126 (40.8)	111.1 (38)
Runs	364.9 (59.2)	378.8 (83.2)	352.8 (85.2)
Jogs	962.5 (111.5)	1002.6 (133.7)	956.2 (146.6)
Duration (seconds)			
Sprinting	30.2 (11.7)	27.9 (14.8)	24.6 (9.8)
HSR	107.3 (30.3)	105.3 (32.1)	94.5 (33.7)
Running	355.9 (67.0)	358.8 (72.1)	351 (79.7)
Jogging	1500.9 (182.9)	1563.6 (167.4)	1521.4 (200.5)
Walking	3491.4 (241.9)**	3426.7 (217.9)	3362.1 (311.8)**
Other			
Recovery (s)	52.1 (13.6)	57.1 (33.6)	62.3 (22.6)
Relative Intensity	1.2 (0.3)	1.2 (0.4)	1.1 (0.4)
Distance per minute	110.8 (9.8)	112.8 (8.4)	111.9 (9)
Top Speed (m/s)	9.1 (0.3)	9.0 (0.5)	9.0 (0.3)

* $p < 0.05$, ** $p < 0.01$.

DISCUSSION When 3 matches were played in 5 days activity profiles revealed that players were able to recover when the total distance is considered, although some residual fatigue may be apparent which affects certain HI aspects of play. This finding is supported by altered HI activity profiles, which may influence the way teams approach training and preparation during future intense playing schedules.

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Mohr et al. (2003) *Journal of Sports Sciences* **23,** 521-528.

KEY WORDS Activity profiles, recovery, fatigue, soccer players, prozone, high intensity activity.

O-022 A dynamical analysis of momentum in football

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OBJECTIVE The current paper discusses and reviews the application of momentum within performance analysis of soccer, incorporating some components of dynamical theory as a means of interpreting these data and identifying the critical periods of a match. This paper extends the ideas presented by previous research (Hughes et al., 2006; Reed et al., 2006) to explore the significance of momentum within team sport when considered from a dynamical perspective.

METHODS Over 85,000 pieces of raw match data (N=38), courtesy of ProZoneTM, from one English Premiership Football team were interpreted using algorithms and simple numerical values.

RESULTS Within this study, the system itself is composed of positive and negative instances, each corresponding to a discrete event within the match itself. Perturbations therefore exist where the momentum profile is disturbed, commonly leading to an observed shift in state.

DISCUSSION The identification of these perturbations within the momentum profile could provide benefits from a physiological and psychological perspective, in addition to influencing immediate or post-event tactical change. With the integration of computerised analysis and video technology, players and coaches can then review those periods of play identified as critical to performance.

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Hughes et al. (2006) *International Journal of Performance Analysis in Sport* **6**, 161-171.
Reed et al. (2006) *An Exploration of Team Sport as a Dynamical System*. In: *Notational Analysis of Sport VII.* Eds: H. Dancs, M. Hughes and P. O'Donoghue. Cardiff: UWIC.

KEY WORDS Momentum, dynamic systems, profiling, perturbations.

O-023 Intelligent system of tactics' analysis in a soccer team

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OBJECTIVE Soccer players act in time and space inside an unpredictable environment that often complicates team work. When organizing a team play, the main task is to provide coordinated actions of players, all trying to realize their individual actions. Thus, the behaviours of soccer players as a team is a more complex phenomenon than coordinated individual actions of separate athletes. We are building a digitized soccer match analysis tool and implementing situation patterns in a real match. The goal of this study was to create an intelligent system of tactics analysis (ISTA) in a group of interacting players in game situations and during tactical training exercises. To create the ISTA, we used multi-agent technologies elaborated by specialists in artificial intelligence.

METHODS Qualitative spatial reasoning was used to determine the game pattern, which exists on field at certain moments. 3 layers were distinguished in cognitive agent: physical actions, individual and coordinated behaviour. Experimental connection of size and distance was defined in Table1. Spatial situation on field was described by determination of spatial relations between players, ball and goal. We use qualitative spatial reasoning to determine the game pattern, which exists on field at certain moment.

RESULTS In this study 4 games of European teams, 10 games of Russian national and 2nd Division teams were analyzed. The higher qualification a team had, the less number of interactions it demonstrated in separate episodes, but the number of tactical schemes grew both in attack and defence (Table 1). We determined strong and weak tactical interactions of different level used by a team against tactical actions of an adversary.

Table 1. Connection of object size and distance.

	Small&small	**Middle-sized&middle-sized**	**Big&big**
small	near	near	near
middle-sized	not far	near	near
big	Far	not far	near

DISCUSSION The Intelligent System of Tactics Analysis for automatic situation recognition in a group of players was realized as a hybrid system with the use of the expert system, fuzzy controllers, and artificial neural network. It is a successful attempt to describe collective behaviour of people solving a common goal with the use of a knowledge-based hybrid system.

KEY WORDS Tactics analysis, multi-agent technologies, artificial intelligence, automatic situation recognition, collective behaviour.

O-024 Successful performance in soccer: team kinematics of goal-scoring opportunities in small-sided soccer games

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OBJECTIVE In recent years, growing interest in performance analysis and technological innovations has led to new forms of match analysis techniques. A systematic approach seems to provide a promising framework for the analysis of goal-scoring opportunities (Gréhaigne et al., 1997; McGarry et al., 2002). In this study, we propose two variables; centre of teams (team pressure) and surface area (team position). The objective was to test the hypothesis that changes in the centre position of teams and changes in surface area precede goal-scoring opportunities. Besides, we expected to find a phase relation for the centre position of teams.

METHODS Ten elite youth soccer players, aged 16-18, participated in this study (2 goalkeepers, 8 outfield players). Two 4-a-side games of 4 minutes were played on a 35x40m pitch. No instructions were given with respect to game playing. Player positions were recorded by means of an innovative Local Positioning Measurement system (LPM) at 50 Hz. Both matches were videotaped.

RESULTS Results show that in 7 out of 9 goal-scoring opportunities, changes in the centre position of teams and in surface area precede a goal-scoring opportunity (Figure 1). Furthermore, a phase relation characterizes the displacement of the centre position of teams.

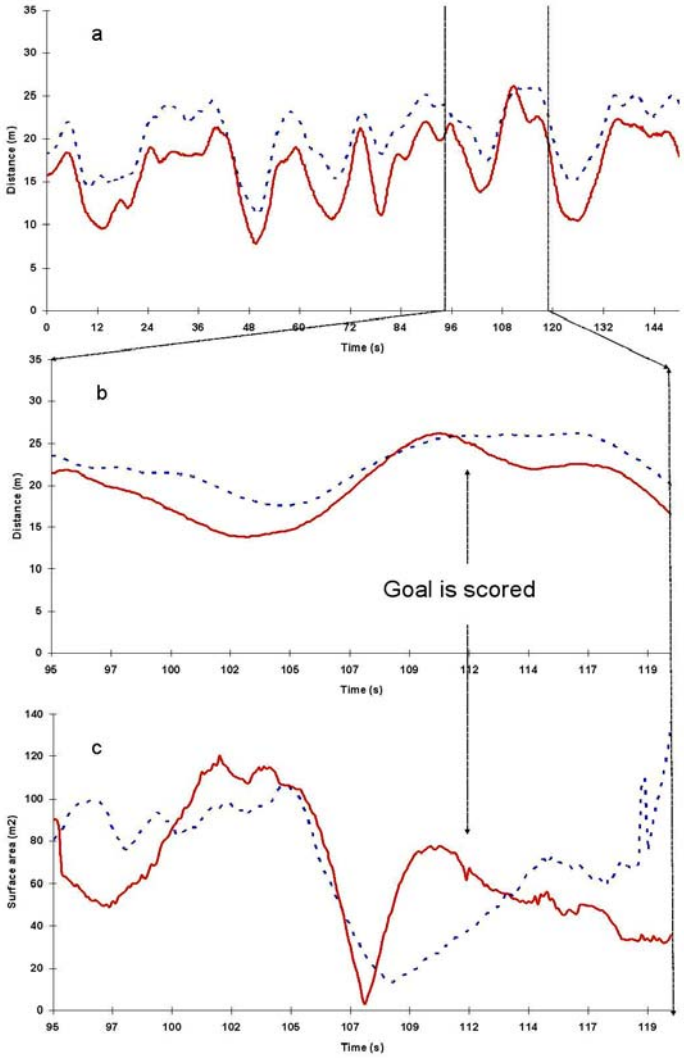

Fig. 1: a) Phase relation center of teams, b) Center of teams as a goal is scored, c) Surface area as a goal is scored.

DISCUSSION Changes in the center position of teams, accompanied by changes in surface area, indicate goal-scoring opportunities. It is shown that these variables are promising with respect to the systematic analysis of soccer games. Ongoing studies focus on the effects of task constraint manipulations on these variables during small-sided soccer games.

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KEY WORDS Soccer, match analysis, systematic approach.

O-025 Match analysis of 2005-06 Champions League Final with Amisco system

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OBJECTIVE The analysis of football matches is nowadays one of the bases among the process of soccer training. There are many systems to register and edit the matches that are already being used by football clubs. The Amisco system is being applied since 2001-2002 season, by some of the most important football clubs in the Spanish, French, German and English leagues. The objective of this communication is to show the main characteristics of one of the most advanced systems to analyse matches, the AMISCO® system, and its application for the analysis of a referential match: 2005-06 Champions League Final Match.

METHODS A setting of eight cameras and several computers was installed in the Stade de France. The match was recorded and digitalized and, in the production centre, the player's position and movements were registered with a frequency of twenty-five records per second. Every player's actions with the ball are registered as well. High levels of reliability, validity and accuracy were obtained (Zubillaga, 2006).

RESULTS The FC Barcelona makes 22 shots, 45% on target. Arsenal FC makes 9 shots, 55% on target. The players of FC Barcelona run, at average 10339 meters. The players of Arsenal run at average 10549 meters. The distances run over 21 km/h, were 460 m for the FC Barcelona players and 410 for the Arsenal players. The highest distance in one half at more than 21 km/h was registered to Eto'O (394 meters).

Table 1. Tactical and physical data obtained in 2005-06 Champions League Final Game by using Amisco®.

Tactical Data		**SHOTS**	**ON TARGET (%)**	**CROSSES**	**PASSES**	**COMPLETED PASSES (%)**	**GOALS**
FC BARCELONA	**1st half**	9	44	9	342	85	0
	2nd half	13	46	17	374	89	2
ARSENAL FC	**1st half**	5	60	4	188	78	1
	2nd half	4	50	4	116	62	0
Physical Data (Covered Distances)		0-11 km/h	11-14 km/h	14-21 km/h	>21 km/h	TOTAL Distance	
FC BARCELONA	**1st half**	3448	645	834	194	5121	
	2nd half	3423	647	882	266	5218	
ARSENAL FC	**1st half**	3636	670	789	202	5297	
	2nd half	3523	659	861	208	5252	
Maximun Distances		Fabregas 3850 (1st Half)	Gilberto Silva 1048 (1st Half)	Deco 1578 (1st Half)	Eto'O 394 (2. half)	Fabregas 6090 (1st Half)	

DISCUSSION The analysis of the registered data with AMISCO system was done from a double perspective. Firstly, the viewing of the player's group actions, through the showing of the match in a two dimension view, complemented with the video. The second perspective, allows through a statistic way, the analysis of the data that refer to the player's physical, technical and tactical performance during the match. The results showed the performance level in this Final Game were congruent to the results founds in season games (Zubillaga, 2006).

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KEY WORDS Soccer, match analysis, computer analysis, video analysis.

O-026 Provision of FIFA on government interference in administration of national football federations: hindrances to full compliance in Africa

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OBJECTIVE FIFA was founded on 21st May, 1904 in Paris by seven members from France, Belgium, Switzerland, the Netherlands, Denmark, Sweden and Spain. In accordance to article 2 of its constitution, FIFA is empowered to regulate and develop international football and protect the interests of its members. Today FIFA has 204 affiliated members spread over the continents of the world. One of the most important issues that have generated lots of friction between FIFA and National football Associations (NFs), especially those in the continent of Africa is the non-compliance with the provisions of Section II, Article 17 of FIFA's statutes, which demands government's non-interference in the administration of NFs.

METHODS The Nigeria Football Association (NFA) shall be the case study for this position paper. The author feels that most of the hindrances confronting NFA and inhibiting it to adhere to Art. 17 are the same hindrances confronting other NFs in Africa. Some of these hindrances include politics, funding, facilities, sponsorship, and personal interest, among others.

RESULTS In examining the issue of hindrances to full compliance to Art 17 of FIFA's statutes, it was revealed that NFs found it difficult to comply due to the facts that leadership and membership of NFs were most often decided by political and tribal affiliations and not necessarily by competence, and that leadership positions were given to those who would succumb to the demands of those in government.

DISCUSSION There is no doubt that NFs in Africa do face a lot of hindrances towards their intention to comply with Art. (17 of FIFA Statutes). This was due to the fact that football administration in Nigeria, as in most African countries, was still subject to the control and authority of those that administer sports on behalf of the Federal Government of Nigeria.

KEY WORDS FIFA, Government interference, hindrances, sponsorship.