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MATCH ANALYSIS IN TEAM SPORTS

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A mio padre

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Contents

Appendix

Research Posters

Review of the relevant literature

Abstract (English Version)

Match Analysis is a major subject among coaches, team managers and sport scientists and it is gaining an increasing relevance day by day. *Information* and the relevant *data processing* are the key factors while referring to this aspect of the sport training methodology.

Currently the concept of "Match Analysis" is used in several countries to define the process of observing and evaluating a "whole of behaviours" performed by the players during a match, applying different methodologies and using specific instruments and tools, in order to:

1. **collect** and **process** the relevant **data** concerning the different features of games or athletic disciplines, under different points of view;

2. **provide relevant presentations**, appropriately formatted, in order to show the collected and processed data in an *accessible way* to all the concerned people, at different levels (i.e. coaches, players, sport scientists, officials, managers, journalists, etc.);

3. **provide an interpretation** of the collected and processed data, in order to define better some specific feature of the investigated performance (i.e. the physiological side of the performance or the biomechanics or the tactical features of a match or a game) with the ultimate aim of improving these aspects through the appropriate administration of the relevant training processes.

The aims of the thesis may be summarized as follows:

1. providing a *large-scale overview* of what is currently the role of the *Match Analysis procedures* in the general context of the training methodology;

2. analysing the *professional profile (Study 1, Chapter 11)* required to operate in this specific field and the *attitudes* of the possible Match Analysts, the Sport Sciences students, through a questionnaire purposely designed;

3. providing an example of *Quantitative Biomechanics Analysis, (Study 2, Chapter 7)* investigating a specific hockey technical skill, *(the "Push")* often performed during a match in order to cope efficiently with the *"Competition Invariants"* situations (Free Hits, Corners, Penalty Stroke, etc.);

4. in order to define the relevant physiological performance indicators (match analysis, level 1) in field hockey, an extensive analysis of the motor abilities and the fitness levels has been carried out and presented *(Study 3, chapter 7)* for elite (international level) and sub-elite (national level) women hockey players;

5. describing some applied *Qualitative* and *Quantitative Match Analysis* procedures *(Field Hockey, Football; Study 4 and 5, Chapter 8 and 13)*, through the process of:

   • analysing the commercial Video Match Analysis software available on the market at date;

   • using a video match analysis commercial software to collect data at international/national level in team sports such as Field Hockey and Football;

   • designing a new software able to improve the efficiency of the used video data base;

   • analysing the collected information, by the means of *Data Mining*, in order to provide the relevant *Performance Predictors*, suitable to improve the training processes and to help consistently the work of coaches even in real-time situations.

Some *final considerations* are provided, suggesting the need for more and further investigations for the most part of the third level of analysis (General Strategy and Tactic). A greater involvement of the Universities is needed in order to qualify the future Match Analysts, ensuring them the appropriate knowledge of several and different disciplines that combine a pertinent interdisciplinary approach.

Key Words: Match Analysis, Team Sports, Situation Sports, Competition Invariants, Data Mining, Artificial Intelligence, Qualitative Biomechanics, Quantitative Biomechanics

Abstract (Versione Italiana)

La Match Analisi è argomento di discussione di grande interesse fra gli allenatori, i dirigenti sportivi e gli studiosi di scienze dello sport, e sta raggiungendo giorno per giorno una sempre maggiore rilevanza.

Quando ci si riferisce a questo particolare aspetto della metodologia dell'allenamento sportivo, l'*Informazione* e l'*elaborazione dei dati pertinenti* devono essere considerati i *fattori chiave*.

Attualmente il concetto di "Match Analisi" è usato in diversi paesi per definire il processo della osservazione e valutazione di un "insieme di comportamenti" adottati dagli atleti durante una partita o incontro, applicando diverse metodologie ed utilizzando specifici mezzi e strumenti, al fine di:

1. **raccogliere** ed **elaborare** i dati relativi ai diversi aspetti di un gioco o di alcune discipline sportive, sotto diversi punti di vista;
2. **fornire le relative risultanze**, opportunamente formattate, al fine di presentare i dati raccolti ed elaborati in un modo accessibile a tutti gli interessati, a diversi livelli (es. Allenatori, Atleti, studiosi di Scienze Motorie, Dirigenti, Giudici ed Arbitri, Giornalisti, ecc.);
3. **fornire una interpretazione** dei dati raccolti ed elaborati, al fine di definire meglio alcune caratteristiche specifiche della prestazione studiata (p.es. il dato fisiologico della prestazione o la biomeccanica o gli aspetti tattici di una partita o di un gioco) con il fine ultimo di migliorare questi aspetti attraverso la proposizione opportuna dei relativi processi di allenamento.

Le finalità di questa tesi possono essere sintetizzate come segue:

1. fornire una *panoramica a larga scala* di quello che è il ruolo delle procedure di Match Analisi, inserite nel contesto generale della metodologia dell'allenamento sportivo;
2. analizzare il *profilo professionale (Studio 1, Capitolo 11)* richiesto per poter operare in questo campo specifico e gli *atteggiamenti* dei possibili Match Analisti, gli studenti di Scienze Motorie, attraverso un questionario appositamente progettato;
3. fornire un esempio di *Analisi Biomeccanica Quantitativa*, *(Studio 2, Capitolo 7)* studiando una specifica tecnica hockeistica, il "push", utilizzato spesso durante una partita, al fine di affrontare efficacemente le cosiddette *"Invarianti di Competizione"* (Tiri Liberi, Corners, Rigori, ecc.);
4. condurre e presentare *(Studio 3, Capitolo 7)* una analisi estensiva delle capacità motorie e dei livelli di condizione fisica nelle hockeiste di elite (livello internazionale) e sub-elite (livello nazionale) al fine di definire i possibili indicatori fisiologici di prestazione (livello 1 della Match Analisi);
5. descrivere alcune procedure applicative di Match Analisi Qualitativa e Quantitativa *(Hockey, Calcio; Studio 4 e 5, Capitoli 8 e 13)*, attraverso i processi di:

- analisi dei software di Video Match Analisi disponibili sul mercato attualmente;
- uso di un software commerciale di video match analisi per raccogliere dei dati a livello nazionale/internazionale in giochi sportivi come l'Hockey su prato ed il Calcio;
- progetto di un nuovo software capace di aumentare l'efficienza del Data Base Video utilizzato;
- analisi delle informazioni raccolte, attraverso un programma di *Data Mining*, al fine di trovare gli opportuni *Predittori di Prestazione,* capaci di ottimizzare i processi di allenamento e di aiutare in modo consistente il lavoro degli Allenatori, anche in situazioni di tempo reale.

Sono proposte alcune *considerazioni conclusive*, che suggeriscono la necessità di maggiori ed ulteriori ricerche, per la maggior parte relative al terzo livello di analisi (la Strategia Generale e la Tattica). Un maggior coinvolgimento delle Università appare opportuno al fine di qualificare i futuri Match Analisti, assicurando loro le opportune conoscenze nei diversi ambiti disciplinari che possono concorrere a permettere un opportuno approccio interdisciplinare.

Parole Chiave: Match Analisi; Giochi Sportivi, Sport di Situazione, Invarianti di Competizione, Data Mining, Intelligenza Artificiale, Biomeccanica Qualitativa, Biomeccanica Quantitativa

1.   Introduction

Match Analysis is a major subject among coaches, team managers and sport scientists and it is gaining increasingly relevance day by day. *Information* and *the relevant data processing* are the key factors while referring to this aspect of the sport training methodology.

Currently the concept of "Match Analysis" is used in several countries to define the process of observing and evaluating a "whole of behaviours" performed by the players during a match, applying different methodologies and using specific instruments and tools, in order to:

1. **collect** and **process** the relevant **data** concerning the different features of a game or athletic disciplines, under different points of view;

2. **provide the relevant presentations**, appropriately formatted, in order to show the collected and processed data in an *accessible way* to all the concerned people, at different levels (i.e. coaches, players, sport scientists, officials, managers, journalists, etc.);

3. **provide an interpretation** of the collected and processed data, in order to better define some specific feature of the investigated performance (i.e. the physiological side of the performance or the biomechanics or the tactical features of a match or game) with the ultimate aim of improving these aspects through the appropriate administration of the relevant training processes.

Match Analysis is an **umbrella term** that encompasses the manifold aspects of a game, investigated by various analysts in order to assess:

1. the **fitness** – the **physiological aspects** of a match (**a level 1 of analysis**);

2. the **technical aspects** of the skills performed during a match, and their relevance while applied during the ***competition invariants*** (**a level 2 of analysis**);

3. the **strategical** and the **tactical** features observable during a game (**a level 3 of analysis**)**.**

1.1. Thesis Focus

The aims of this thesis may be summarized as follows:

1. we will go trough the different aspects of the *Match Analysis procedures*, in order to provide *a large-scale overview* of what is currently the role of this process in the general context of the training methodology;

2. we will analyse the *professional profile* required to operate in this specific field and the *attitudes* of the possible Match Analysts, the Sport Sciences students, through a questionnaire purposely designed.

3. we will provide an example of *Quantitative Biomechanics Analysis,* investigating a specific hockey technical skill, *(the "Push")* often performed during a match in order to efficiently cope with the *"**Competition Invariants"*** situations (Free Hits, Corners, Penalty Stroke, etc.).

4. In order to define the relevant physiological performance indicators (match analysis, level 1) in field hockey, an extensive analysis of the motor abilities and the fitness levels in elite and sub-elite women hockey players will be carry out and presented;

5. we will then describe some applied *Qualitative* and *Quantitative Match Analysis* procedures (Field Hockey, Football), through the process of:

   - analysing the commercial Video Match Analysis software available on the market at date;

   - using a video match analysis commercial software to collect data at international/national level in team sports such as Field Hockey and Football;

   - designing a new software able to improve the efficiency of the used video data base;

   - analysing the collected information, by the means of *Data Mining*, in order to provide the relevant *Performance Predictors*, suitable to improve the training processes and to help consistently the work of coaches even in real-time situations.

Main idea

We think that there is still a confusing concept of Match Analysis, with a redundancy of information referring to the level 1) of analysis (the one mainly referred to the energy aspects of the game – at fitness level), some information regarding the biomechanics of the skills to be performed during a game, mainly in order to cope with the competition invariants (level 2) and a marked lack of information and proper

procedures of analysis, able to understand and to explain the strategical and the global tactical aspects of the game (level 3).

We suggest that a new interdisciplinary approach is needed, in order to explain the complex of behaviours adopted by the players while competing in a game. Some suggestions could derivate from the *mathematical modelling* issues, proposed by the *physical sciences* and by the *economics*, from the new studies on *behavioural analysis* and from the possible implications offered by the researches on *artificial intelligence*, especially referring to the **data mining routines**, whereas computers can truly help in making interesting variables associations, roughly identifiable by the human eyes.

We also believe that an important role should be played by the Universities in order to better qualify the processes of Match Analysis, through specific training courses aimed at highly qualifying the future *Match Analysts,* whose professional profile is gaining relevance day by day in top sport's world.

The *Main Idea* of this Thesis is providing a contribution to better define the **process of Match Analysis in Team Sports**, particularly underlining the relevance of a new approach to this issue, (a "third level" of analysis), besides the traditional ones, mainly focused on the fitness and some biomechanical aspects of the sports. Therefore we will highlight the relevance of exploring the possibilities given by the new technologies, looking for what Professor Antonio Dal Monte told us more than 25 years ago, when he stated: *"time has come to provide new eyes for the coaches…"*[1] .

1.2. Thesis Outline

The thesis is organized in 13 chapters that highlight the relevance of the different issues related to the Match Analysis procedures and they also provide several results obtained through the specific research projects carried out by the author. Each chapter presents a relevant Reference section. An Appendix of research, dedicated to the **Review of the relevant literature and other issues** is also provided.

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[1] Dal Monte A.; "La Ricerca Scientifica applicata allo Sport" in SDS – Scuola dello Sport – CONI, 1, 0, November 1982, pp. 2-9

Chapter 1: Introduction. This chapter will present to the reader the general aims of this thesis, explaining its inner structure and the different features investigated in this work.

Chapter 2: Introduction to the Match Analysis Processes. An overview of the general meanings of the Match Analysis procedures is provided: the origins, the fields of application, the kind of analysis that can be undertaken.

Chapter 3: Sports Classification. Sports are seen and classified under different point of views; in order to provide different key-codes for the Match Analysts to appreciate the ongoing matches, the author suggested the most known and used sports classifications.

Chapter 4: Conditioning, Training and Coaching (CTC) Processes and Controls. This chapter is about the Sport Conditioning, Training and Coaching processes and their connections with the Match Analysis procedures. The evolution of the concept "training as a process" is here emphasized. The Sociological and Pedagogical issues are also presented, in order to better define a general framework.

Chapter 5: Analysing the CTC Processes: an interdisciplinary approach. The need to investigate Team Sports with an interdisciplinary approach is here emphasized. The different domains that might combine in Match Analysis procedures are briefly presented here.

Chapter 6: Match Analysis Procedures. This chapter is about Match Analysis applied methodology. Different aspect of M.A. procedures are highlighted, in order to present the *state of the art.* The section *Advanced Biomechanical Analysis in Situational Sports* is a brief presentation of the precious works carried out by professor Sacripanti over the past years.

Chapter 7: A first level CTC Process – Fitness Conditioning and Skill Training. In this chapter two different case studies, carried out by the author, are presented. The first one is referred to the research of "physiological indicators" in field hockey performance. Indicators are important "tools" in the "everyday work" of Match Analysts. The Repeated Sprint Ability (RSA) confirmed its predominance among the investigated abilities. The second study was aimed at defining the biomechanics of a particular and significant hockey technical skill, the "push". This research was performed thanks to a protocol agreement signed by the University of Sport Science

of Rome (IUSM), now called University of Rome, "Foro Italico", and the University of Rome Tor Vergata, Faculty of Medicine, Sport Science Department.

The procedures of acquisition of the relevant data were performed at the Department of Human Movement and Sport Sciences of IUSM, directed by Professor Aurelio Cappozzo.

Chapter 8: A second level CTC Process – The local strategies and the Competition Invariants. This chapter is about the concept of Local Strategies and the implications in skills performance. The author presents here the concept of "Semi-closed skills", namely those skills that require a higher level of standardisation even if applied in Team Sports performances. Free-hits, penalty corners in Hockey, Corner, Free-Kicks, Penalties, Serving, etc. in other situation sports (Football, Basketball, Volley) heavily rely on the perfect execution of particular skills to be performed under the extreme pressure of the ongoing situation but, nevertheless, require the higher degree of stability and precision, that are common parameters in "closed-skills".

Chapter 9: A third level CTC Process –The global strategies and the Tactics. The chapter is about strategies and tactic. These aspects are the most relevant according to many top coaches in Team Sports. We present here a third case study, *"Quantitative-Qualitative Match Analysis in Football: Strategy and Tactic"* analysing the performances of top football players of A.C. Roma and S.S. Lazio, in order to define the possible tactical profiles relating to a specific role (the Centre Back) .

Chapter 10: Methodology of Observation and Evaluation Processes. Scientific observations are carried out using specific guide-lines. Match Analysis is a form of the *systematic observations processes* and has to follows rigorous lines of research in order to achieve significant and reliable results. The basic observing and recording tactics are provided here.

Chapter 11: Match Analysis and the possible Professional Profiles. This chapter is about the Match Analysts' work. We present a fourth case study, investigating this issue through a questionnaire. We examined the possible fields of intervention related to the Match Analysis procedures in Team Sports methodology and the Match Analyst professional profile, whose relevance is gradually increasing within the coaching staffs of high level teams. We also focused on the possible

education and on the required training aspects of such a profile, investigating some relevant attitudes of the Sport Sciences students at the University of L'Aquila (Italy), through a structured questionnaire, designed by the authors.

Chapter 12: Descriptive and Probabilistic Statistics applied to Match Analysis. This chapter is about Statistics and its connections with the Match Analysis procedures. Various statistical techniques are necessary to describe the characteristics of data, test relationship between set of data, and the differences among sets of data. Any Match Analysis procedure should be able to provide data that could be processed and interpreted in order to add more knowledge to the possible "clients": coaches, trainers, scholars in Sport Sciences, etc. A brief introduction to the relevant statistics issues, pertaining to the process of Match Analysis is provided.

Chapter 13: A Case Study: Field Hockey, Information and Training: the winning duet. This conclusive chapter is about the fifth case study, carried out by the author during the World Women Hockey Olympic Qualifier held in Victoria (Canada) in May 2008, before the Olympics in Beijing. As a part of the three years course of Doctorate, we designed and programmed a software that helped consistently the work of the coaches during this top Tournament (the "IAC" software). The research was aimed at verifying the possibility of forecasting the possible results in a particular and really important aspect of the game: the short corner, that usually heavily influences the final outcomes of the matches. A Data Mining software was also used in order to find the best predictors of performance. The results of this research was presented by the author in June 2008 at the Verona-Ghirada Team Sports Conference.

Conclusion. Final considerations are provided, suggesting the need for more and further investigations, for the most part about the third level of analysis (General Strategy and Tactic). A greater involvement of the Universities seems to be opportune in order to qualify the future Match Analysts, ensuring them the appropriate knowledge of several and different disciplines that may combine to undertake a pertinent interdisciplinary approach.

Appendix

Two Research Posters are also provided in this Appendix. They were presented at the Team Sports Conference, held in Verona-Ghirada, by the University of Verona, Faculty of Sport Science, in June, 2008.

Review of the relevant literature. An overview regarding the *state of the art* in Team Sports/ Situation Sports Match Analysis procedures, with a particular focus on the new applications of the Information Technology in this field of research (Artificial Intelligence, Artificial Vision, Data Mining, Computer-aided scenarios, Virtual Reality environments, etc.) is provided.

In its electronic version (.doc), this Appendix is edited as an hypertext. The user may browse the text using the available hot-words linking the summary to the chosen articles.

Chapter 2

Introduction to the Match Analysis Processes

Introduction to the Match Analysis Processes

So it is said that if you know your enemies and know yourself,
you will fight without danger in battles.
If you only know yourself, but not your opponent,
you may win or may lose.
If you know neither yourself nor your enemy,
you will always endanger yourself.

Sun Tzu, "The art of war", VI century B.C.

In a broader sense, Match Analysis, namely the study of a competition, has always existed…

Since the human beings had to cope with the terrible competition represented by the struggle for life, in order to survive, gathering "information" was considered one of the most precious value, to exploit at the maximum extent, in order to grant the biggest chance of victory, in every kind of competition.

Examples of Match Analysis, or of studies of competition, historically occurred (Grimal, 2001; Matthiae et al., 2004) since the invention of writing and even earlier…indeed how not to notice yet in a prehistoric painting (see fig.1) a gathering of information linked to a competition between men and environment, aimed at leaving a memento or a precept, for future behaviours?
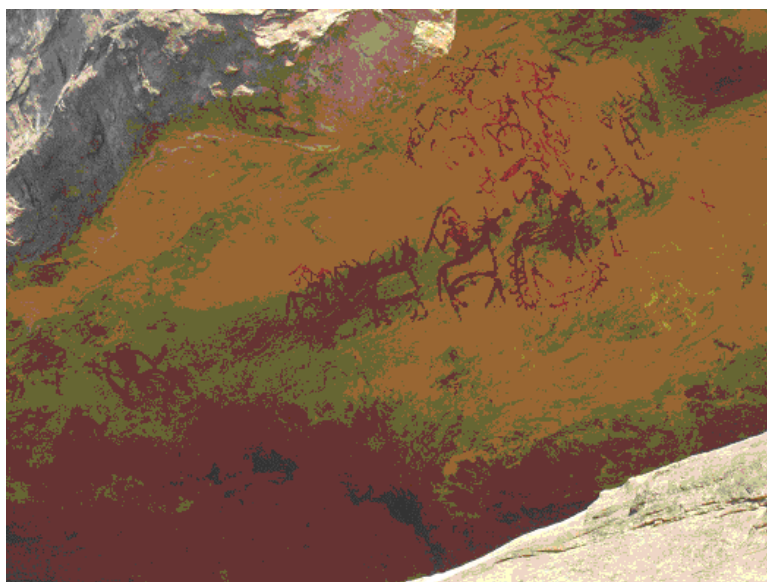
Figure 1 - "The King goes off to war ", 8.000 B.C., Bhimbetka, India

In these rapidly changing days, with the irruption of the telematics and the new technologies, even the sport world is having a slow but irreversible transformation towards a more and more accentuate application of science

methodologies in its every aspect: from the individual performance to the analysis of situational (team or dual[1]) sports.

As always, in front of a predictable revolution, the experts can choose whether to totally refuse such innovations or to accept them, in order to ensure for themselves the best results, moving with the times (Sacripanti, 2007).

It is well known that in the Anglo Saxon culture the interest in scientific methodologies in sport, and therefore their use, is well established since a long time, so it is quite common to see technical staff or team working together as a unit, in perfect harmony, on a squad or a single athlete (see fig. 2)

Perhaps in Italy, introducing science and new technology in sport is facing greater resistances than elsewhere, because of a general more selfish attitude of our culture, that obstacles a "team approach", which is necessary to a fully exploitation of the new technologies.

"Coaching Science" is a crucial part of Sport Pedagogy (Haag, 1994).
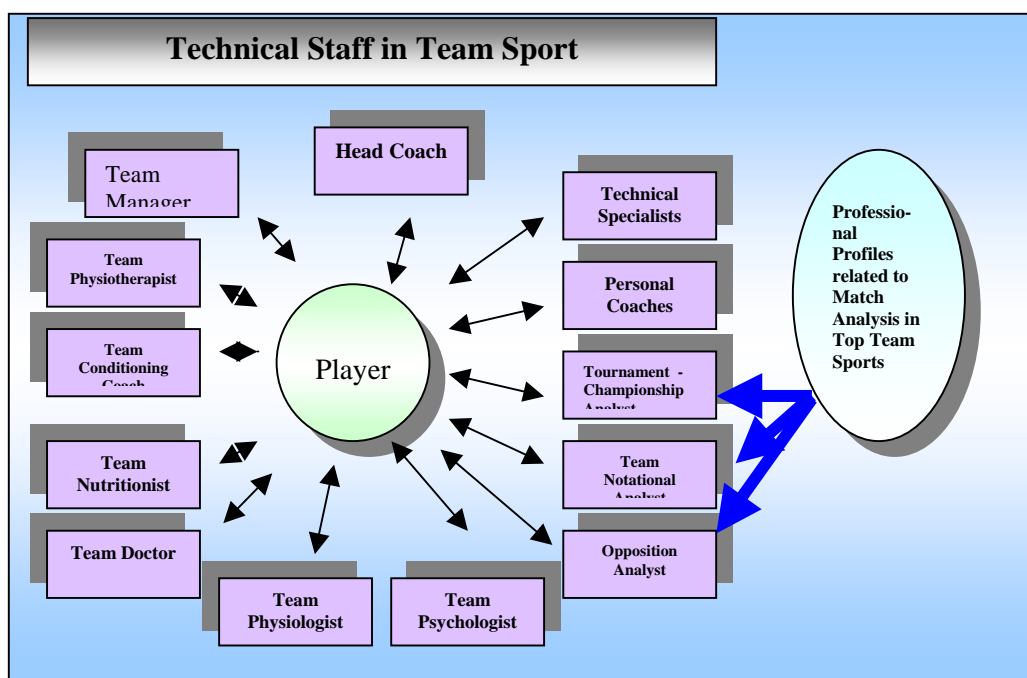
Figure 2 – Technical Staff in Top Team Sports. Note three professional profiles related to the Match Analysis procedures. Franck Dick, 2006.

As it happened in Medicine, where the introduction of new technologies did not negatively altered the Physician's professional profile, representing on the contrary a real evolution of this profession, making him able to operate with less invasive

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[1] for "Sport Classification" see Chapter 3

means and in earlier unexpected fields, so in the sport context the ability of coaches to manage efficiently the new technologies will lead them to better cope with the difficulties of their work, making them achieve ever increasing and better results.

Indeed Match Analysis can represent, especially in Team Sports, a new critical instrument, perfectly designed in order to better understand the complex phenomenon of situation sports and help consistently the work of coaches and their technical staffs in preparing and leading teams to winning competitions.

2.1   Definition of Match Analysis

Match Analysis, in situation sports, is a branch of Sport Pedagogy and Sport Sciences. Several disciplines, at different levels and extensions, combine to bring descriptions, classifications, eventually explanations and also to provide possible forecasts about some of the most significant situations that could be marked during sport events or matches.

As we can see hereinafter, such analysis can be oriented to mark in a **Quantitative** or **Qualitative** sense (or **Quanti-Qualitative**) the aspects that can better highlight the sport performances, under different point of views. In fact there is a line of research linked mostly to the energetic features of the performance (Murphy et al., 2003; Spencer et al., 2005; Sacripanti, 2004, 2007), concerning essentially the **motion-analysis** of the involved players or athletes; another field, concerning the occurrence and the frequency of certain kind of typical events is the **notational analysis** (Hughes and Franks; 2004) of sport, and another one is dedicated to describe the possible **temporal patterns** (Madella, 2007) that could explain the nature and the consistency of certain organised tactical behaviours.

Match Analysis can be also described as a *"Behavioural Analysis describing sport performance, coding individual or teams actions, in order to collect information, suitable for the training/coaching process"*[2]. This definition underlines the importance of objective data gathering regarding the evaluation processes, to be used in training, in order to raise the performance levels of individuals or teams.

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[2] Castagna Carlo, mod.; 2003
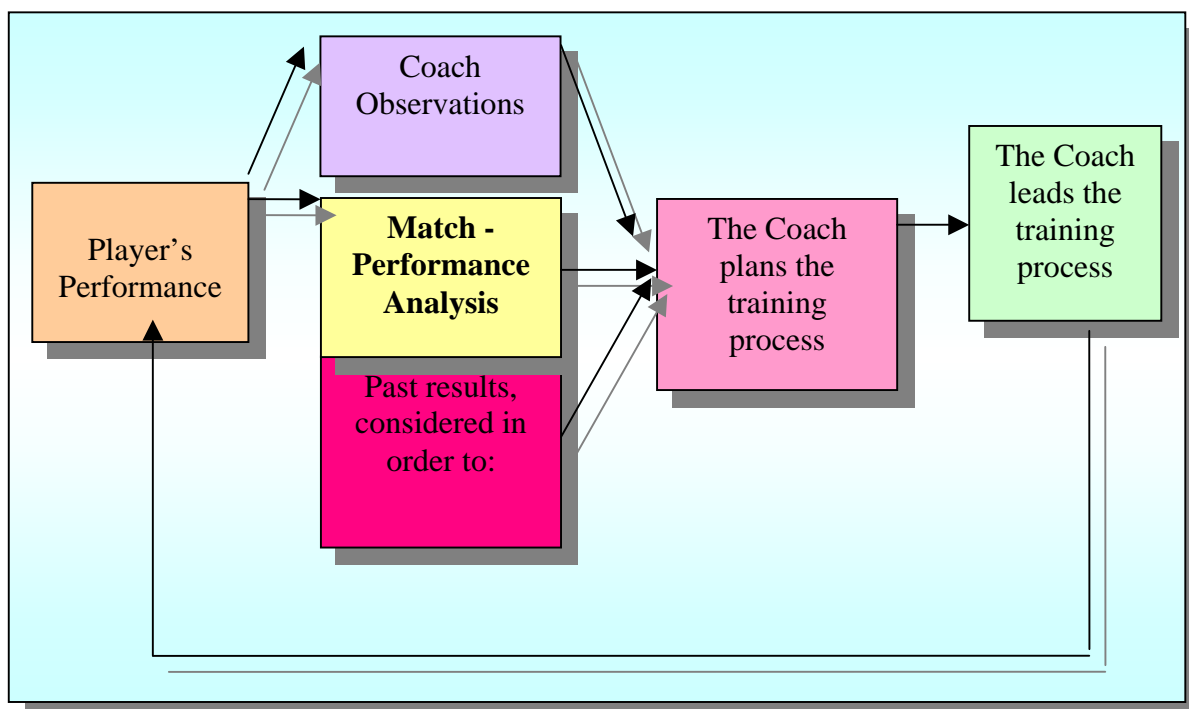
Figure 3 – Relationship between Match Analysis and Training/Coaching Process

This process of analysis aims, with different objectives, at adjusting the pedagogical relationship between Coaches and Players (Figure 3) and it represents a fundamental tool in order to orientate correctly the pedagogical process of sport training and coaching (Pieron, 1989; Sotgiu and Pellegrini, 1989; Weineck, 2001).

A further definition, scientifically correct, based upon "Theory of Games and Economic Behaviours" by Von Neumann e Morgenstern (1944,1947) is:

" Match Analysis is a study on a conflict of interest, based on the Utility Theory"[3].

This definition implies a different approach than the one usually adopted by the vast majority of sport analysts; in fact they often are much more keen on looking for the data concerning the bio-physiological and the biomechanics features of the

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3 The expected utility theory deals with the analysis of choices among risky projects with (possibly multidimensional) outcomes. The expected utility model was first proposed by Daniel Bernoulli as a solution to the St. Petersburg paradox. Bernoulli argued that the paradox could be resolved if decisionmakers displayed risk aversion and argued for a logarithmic cardinal utility function. The first important use of the expected utility theory was that of John von Neumann and Oskar Morgenstern who used the assumption of expected utility maximization in their formulation of game theory.

performance (figure 4), leaving to the "instinct" of the Coach the task of analysing everything related to the Strategical and Tactical area.
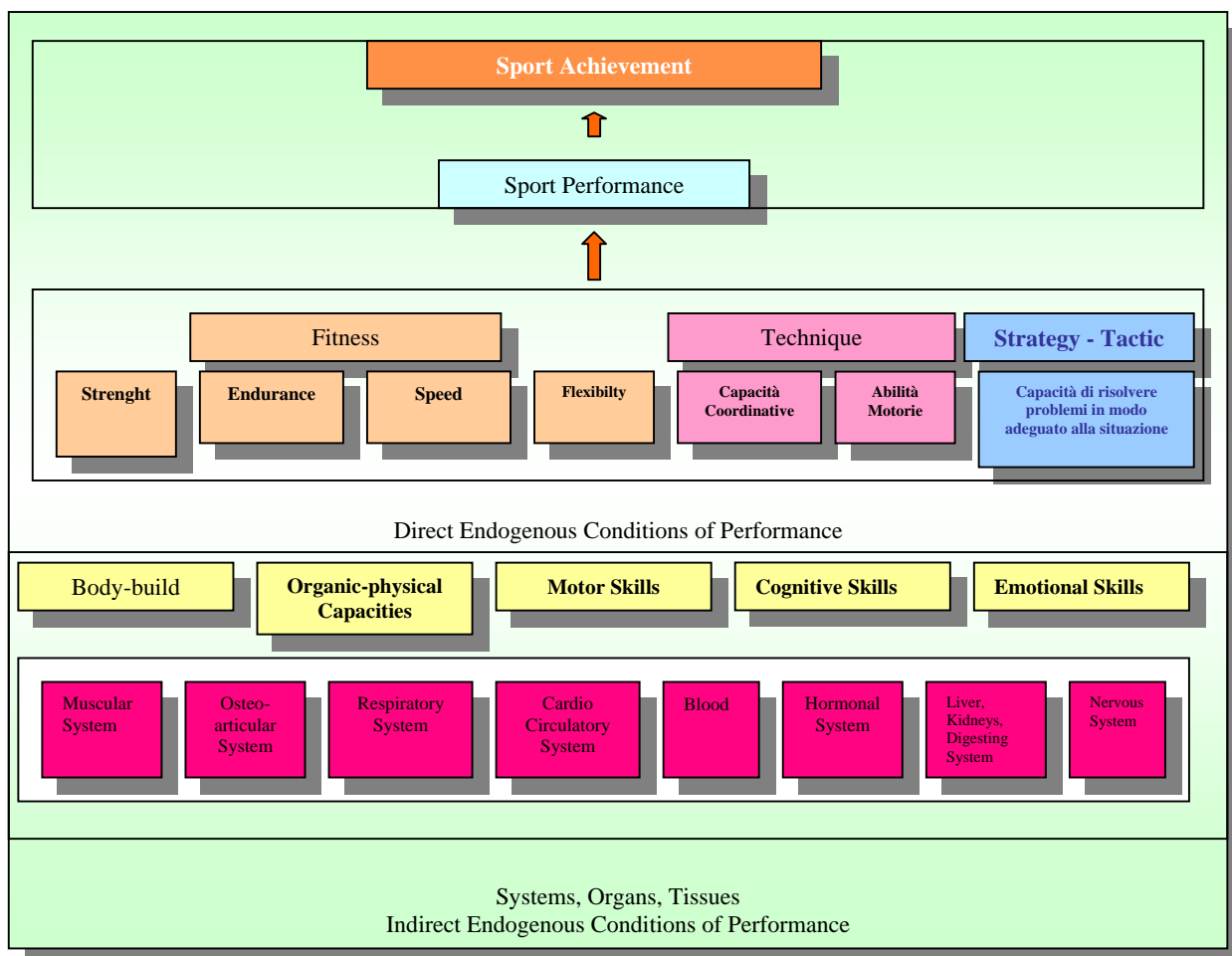
Figure 4 – Components of Sport Performances (Weineck, 2005)

Indeed just in this area seems to reside the ever increasing interest of many *Top Coaches* for research and analysis approaches aimed to a deeper comprehension and evaluation of the Tactical and Strategical features of a Match. The interest seems to raise dramatically whereas a real-time approach is considered, namely able to provide useful information already during the game.

2.1.1 Notational Analysis

Basically **Notational Analysis** is a methodology of analysing performances through **events recording**, according to some previously defined observational plans, in order to provide an accurate, precise and objective recording of what is really going on (Hughes and Franks; 2004).

This systematic observation let adequately trained pesonnell watch, record and analyse the interactions occurring during an event, following well established guide lines and precise procedures, being sure (significative probability) that others observing the same seuquence of events may agree with the data gathered by the first observer, following the same guide lines and procedures (Darst et al.; 1989; Domenici, 1991; Madella et al., 1994).

Ordinary spectators watch differently the same match, often not agreeing on what is happening on the pitch and making many mistakes as observers. Each individual takes with himself systematic observational errors, due to the subjectivity of these observations and to the many errors caused by the human perceiving structures and the subsequent interpretation of the relevant data. It has been proved[4] that even top football coaches are unable to correctly recall most of the game sequences of a match (on average about 70% of information is lost) and very often they are not able even to describe where positive or negative actions originated.

Notational Analysis provides an **effective recording**, it does not lie, on the condition that the methods of data collections are **reliable** and **objective** and the utilized system of analysis is consistent to the analyzed event.

The current and latest methods are much more powerful and complex than the ones used on the first attempts of Notational Analysis. Modern systems allow besides analysis on past matches, even the forecast of future events, on the basis of mathematical-statistical models (Kormelink and Seeverens, 1999; Laird and Sutherland, 2003; Solieman, 2006; Ruscello et al., 2008).

Styles of play and the team patterns most likely to be performed may be simulated both in physical models and in virtual reality sceneries (Tsarouchas et al., 1989; Winkler, Dufour, Partridge, Hughes in Reilly et al., 1993).

Before the computer-aided evolution of the match recording and analysis, a sort of shorthand, designed to a quick and correct record of the observed events, was necessary.

This need essentially rose because of the speed of most of the sport events or actions, such to be excessive to be manually recorded, with an acceptable degree of accuracy.

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[4] Hughes, M.; Franks I.M. (2004); Notational Analysis of Sport; Second Edition; Routledge - TFG; London-New York, pag. 9

Most of the Notational Analysis in Team Sports, such as Football, Rugby, Hockey, are still based on observing the player on the ball, and most of them are still based on a "pen and note-pad" methodology, using grids of observation like the one described below (table 1).

Player	Shot on Goal		Dribblings	
	On target	Off Target	Positive	Negative
A.B.	√√√√	√√√	√	√√√
C.D.	√√	√	√√	√√

Table 1. An easy approach to note shots on goal or dribbling frequency.

Positional data, able to link a specific event to a specific position on the pitch, may be obtained drawing a pitch divided into numbered sectors (Carling, 2005; Ciuffarella et al.; 2008). Position (where?), involved players (who?), observed event (what?), timing (when?) and final outcome (positive or negative) may be so reported.

Such information may provide some match basic statistics, and it can also provide numerical indexes (Darst et al.; 1989) about performance (e.g. individual success percentages) for each observed player.

A less frequently used alternative analysis, is that one referred to the ball motions.
Relevant data may be acquired regarding the frequency of contacts, the number of touches or passes before loosing possession, the speed of the ball motion for each team, and so on.

The resulting information from that research line, together with the positional data eventually collected, may provide a detailed perspective both on the "game intensity or tempo" and on the possible patterns performed and detected.

Many different systems of analysis tried to record the amount and the type of actions performed during attacking phases, in order to assess the different styles of play and to determine whether the various modalities observed (counterattack, positional attack, direct play, etc.) had a greater efficacy in creating goal-scoring chances than each other (Yamanaka et al., Jinshan et al., in Reilly et al. 1993; Yamanaka et al., Luhtanen et al., Sforza et al., Garganta et al., Miyamura et al., Grehaigne et al. in Reilly, 1997).

Current Notational Analysis systems allow data recording directly through a computer. Adapted keyboards and especially the mouse are the most common means of data acquisition. Nowadays a certain and growing use of the voice recognition systems[5] in video-computer recording occurs. These systems let the video operators dictate directly to the laptop a coded description of the match going on, while videotaping the game, never distracting attention from the scene of the ongoing event.

Thus the crucial features of the game may be coded in real time and quickly integrated in a global synthesis to be presented to the coach even during a match or to the players during resting time or time out periods (Ruscello, 2008).

This method is particularly efficient in some sport characterized by high intensity and high frequency of actions (volleyball, basketball, ice/skate hockey, etc.)

The actions coding in relation to the temporal/spatial aspects of the game, just during the video-taping, allows to optimize the time available to the coach or even to the players, in order to intervene almost in real time, to adjust or to correct under a technical-tactical or strategical point of view, once the possible problem is pointed out and the possible solution is identified. These kind of applied methodologies underline the great potential existing in fast data processing in team sport events, in order to cope more efficiently with the ongoing situations and to intervene, according to well established lines, on the individual player or on the team behaviors, right on a second half of a match, as shown in figure 5).

First Half	Rest Time	Second Half
➢ Recording and Coding on a Temporal/Spatial basis. ➢ Extracting the crucial information. ➢ Preparing the sinthesys .	➢ Short presentation of the crucial data. ➢ Technical Tactical corrections. ➢ Upgrading the Strategic Plan.	➢ Recording and coding. ➢ Attainmenting of planned solutions. ➢ Extracting the crucial information. ➢ Preparing post-match analysis.

Figure 5 - Possible use of Notational Analysis during a Match

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[5] In this case the Analyst keeps track of the ongoing match, both in real-time or off-line, using key-words to mark the meaningful actions, thus indexing the relevant video-frames, that are then stored in specific directories. (e.g. www.nacsport.com)

2.1.2 Motion Analysis

Motion Analysis is centered on the raw characteristics of the activities and movements of a single player, with no qualitative evaluation purposes (Carling et al.; 2005) .

It originated from the first "ergonomic" [6] studies and it is about relating a single athlete work-rate to its physiological responses. In their original form, "time-motion analysis" were tools used in order to quantify the industrial yeld and to form an objective basis to build a production growth on. In a very similar way, the performance analysis of an athlete or player, may indicate both the energetic demands of a game or sport event and the athlete self-imposed upper limit during a competition.

Several Motion Analysis methodologies were applied in team sports, such as football, rugby, hockey, basketball, etc. (Reilly, 1993, 1997; Ruscello e Iaccarino, 1995; Hughes and Franks, 2004). The "classic" method used a coded map of the pitch or field, with metric indexes designed in order to help the observer to estimate the distances performed by a single player.

Observed activities are normally reported as single discrete events and assessed in relation to the work intensity of the motion (sprinting, running, jogging, walking, etc.). Usually a comment on the different motion modalities is recorded and then analyzed. This method has been validated by video-taping at the same time the locomotion of the same player and then calculating the pace frequencies and lengths at each intensity stages, recorded for each motion category previously defined.

 This method proved to be reliable in order to identify the fatigue phenomenon, linked to the distances covered by each athletes (Spencer et al., 2005), differentiating by roles or position on the pitch (positional motion analysis – see fig. 6).

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[6] Ergonomics is the scientific discipline concerned with designing according to human needs, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. The field is also called **human engineering**, and **human factors**.
Ergonomic research is performed by those who study human capabilities in relationship to their work demands. Information derived from these studies contributes to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

This particular aspect of motion analysis is still used, especially in commercial broadcasting companies, in order to give a brief index of the working load performed by single players during a game. Under a scientific point of view this method of research still suffers of possible evaluation errors whereas the video recording systems implementation and calibration are not really accurate and precise.

Particularly important is the choice of the observation point to make the video recording from. According to several experts this should be selected in a place well above the pitch or field, directly over the mid-line, in order to grant the best possible adjustment for the optical systems used[7]. Others prefer observation points just above and behind the goals, in order to better understand the tactical motions of the players, but this aspect is little related to motion analysis, and indeed it seems to be more related to a whole performance analysis.

Anyway the operator objectivity and the method reliability need further studies and verifications.
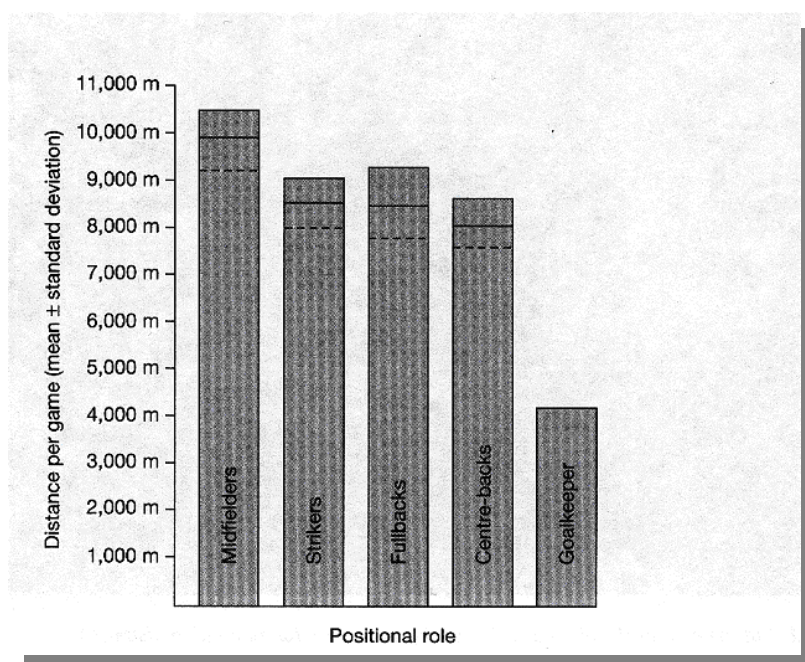
Figure 6 - A Motion Analysis of covered distances (Average + St. dev.) in a football matches in different roles. (T.Reilly e V.Thomas , 1976)

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[7] In this sense a vast scientific literature regarding image modelling and editing is available.

Recently a new approach was proposed by a researcher, that introduced the use of synchronized television cameras, positioned in different places over the pitches (Needham, 2003).

Current computer-aided analyzing systems allow to track a single player by determining his/her motion coordinates (x, y) into the acquisition space, at the beginning and at the end of his/her discrete movement. This particular approach is based on a scaled map of the pitch where the obtained player motion movie is over-imposed. Theoretically the associated error to this methodology is small but still it is required a certain caution in dealing with these procedures in order to minimize the operator error rate.

Current more sophisticated systems are using several fixed cameras, calibrated and linked to each other and managed by a powerful computer. Every players' motions are recorded and the Match Analysis principles (motion or notational analysis) may be applied with a great speed, providing a big amount of information to experts and insiders[8].
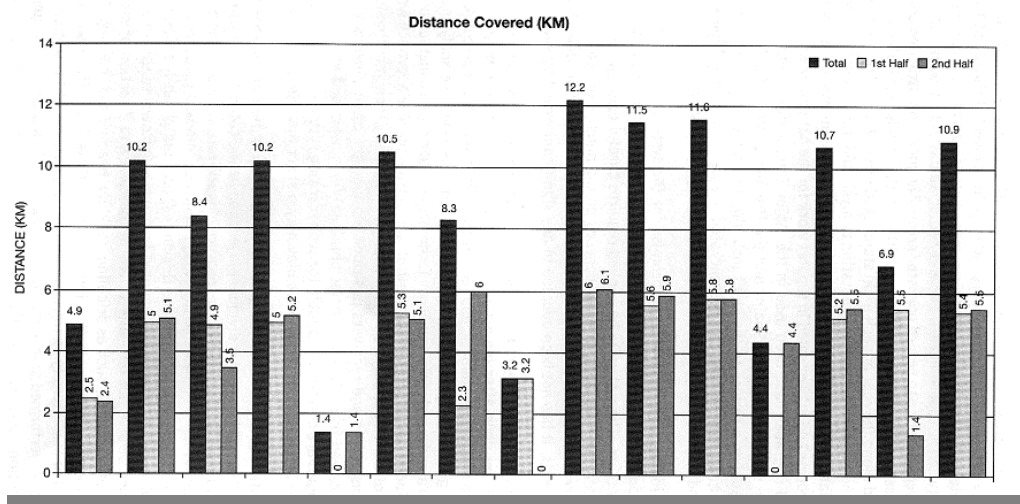
Figure 7 – Football. Computerized Analysis of the Total Distances covered by the players during a Match. (English Premier League)

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[8] A first system being used was designed by *"Sport Universal Process"* and implemented as a support to the work of the French national football team in the 1990s. Upgraded or differently organised versions were then designed and utilised in the major European football competitions, such as the Spanish "La Liga", the British "Premiere League", the Italian "Serie A").

The use of GPS[9] systems seems to be really promising in order to record effectively the players motions and activities during matches and training sessions. This approach is already widely applied in several athletic disciplines, including many team or situational sports. Again very promising seems to be the current systems able to integrate the GPS (or the new coming Galileo) with other devices such as accelerometers or telemetric cardiac recorders[10].

It is noteworthy anyway that the calibration of these devices and the yield of the system are heavily affected by the number of available satellite connections, thus influencing the possibility of errors and their amplitude.

A limitation of the above mentioned methodologies is that the analysis and the interpretation of the data obtained are usually performed after the observed match/event. The relevant data mining could be very demanding and afflicted by human errors, systematic and/or instrumental. A new frontier of Match Analysis, in combination with the new technologies developments and engineering solutions, will be in a not too distant future the "Real Time" approach, able to provide just during a game or a match, significant information directly to the coaches and, in some case, to the involved players on the pitch (Hughes and Franks, 2004).

For example researches carried out utilizing ultra wide radio frequency devices, able to provide an effective real time monitoring on players locomotion, during a game or in training, are really encouraging. By means of an electronic "marking" of the players and through radio devices opportunely set around the pitch it is possible to track all the movements of the players and even of the ball, thus reconstructing all the trajectories and paths performed through the obtained coordinates with this particular approach. We underline that while the existing technology already allow such an approach, many limitations to this procedure are still represented by the rules of many athletic disciplines that expressly forbid the use of electronic devices set on the players during official matches or competitions.

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[9] The Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defense. It is the only fully functional GNSS in the world. It uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals, which enable GPS receivers to determine their current location, the time, and their velocity. Its official name is NAVSTAR GPS. The GPS satellite constellation is managed by the United States Air Force 50th Space Wing. GPS is often used by civilians as a navigation system.

[10] See also http://www.gpsports.com/

2.2 Origins

As stated in the introduction, the need of gather and arrange information is old as the mankind. Such activity, aimed since the very beginning of our civilization at a better chance of competition, in a wider sense, is nowadays applied in a number of situations. It is not a simple case that our age is universally known as the "information era"…

In sport as in life, the need of taking a note of some event or action, in order to recall or analyze them later, is really old. Just think about, for example, (*non sit iniuria verbis*), to the shopping list compiled by every housewives in centuries…(Sacripanti, 2007).

The idea of recording human behaviors is historically well documented. There are evidences that some hieroglyphics were utilized by the ancient Egyptians in order to record some battle strategy plans. The armies used strategic displacements of the forces in war-time, both in land and in sea, and they recorded them in order to analyze the final outcomes, for future improvements.

A sort of short-hand, the so called "Laban Notation" has been even utilised in order to analyse dancing.

People might ask how could the modern match analysis derive its origins. That is, depending on what needs? The obvious answer might be that Match Analysis may be considered as an experimental prolongation of an individual performance analysis, up to the complex case of a couple of athletes competing with each other or a complex system of more athletes (a team) that interacts with another team, as it happens during a match (Sacripanti, 2007).

Historically and for many years Match Analysis was about filling some observational forms by an *experienced observer* during the competitions.

The method of using **coded notes** in order to analyze sport events was first adopted by some U.S. coaches, especially in basketball and in American football.

The utility of such an approach was earlier discovered in "racket sports", where it reached a certain level of sophistication before being considered in football and in other team sports.

In an intermediate phase, with the advent of the information technology, people switched to more sophisticated data processing methods, although these data were collected still with the "observational cards or sheets" system. Later on people used

video taping with manual procedures of data analysis. Current system are much more powerful and complex than earlier attempts, to code activity in real time, using manual or even audio-tape recordings. Contemporary uses go beyond the analysis of recent matches to the prediction and modelling of forthcoming contests. Styles of play and likely patterns of movement can be simulated either as physical models or as computer-driven reality scenarios.

Prior to the evolution of computer-aided techniques for recording and analysing match activities, some form of shorthand was needed to record events accurately. The need arose because activities occurred too rapidly for them to be noted manually with any degree of accuracy.

One approach was to record matches on film or video tape and review the game subsequently. This was the strategy for the family of methods that became known as **motion analysis**. An alternative was to adopt a system of coding those activities that were characterised as relevant to an assessment of performance in the game, which would allow the events to be notated and later collated. As stated before this line of approach has been termed **notation analysis**.

Most systems of notational analysis focus on the players engaged in activity with the ball and on strategic/tactical aspects of performance. The most commonly employed systems are pen and paper based and involve a form of shorthand notation using tally marks or action codes.

Positional data may be recorded by breaking down a schematic pitch representation into numbered zones. The position (where?), the players involved (who?), the action concerned (what?), the time (when?) and the outcome of the activity (e.g. successful or unsuccessful, or on target or off target) are recorded. The analysis is then moved on to the next immediate point of action or contact with the ball: for example, who made the tackle, in which part of the pitch, at what moment in the game and was possession gained? This information provides basic match counts which can then be assessed for **success rates** of actions such as headers, tackles, passes and shots for individual players. A less frequently used alternative strategy is to concentrate on movement of the ball. Data can be registered for the frequency of contact, number of touches or passes in a move before possession is lost, the speed of ball movement by each team, and so on. The resultant information, along with data regarding position on the pitch, can yield valuable insights into the intensity as well as the pattern of play. Various systems

have tended to record the number of actions in attacking sequences in order to look at the playing styles and determine whether direct or possession play is more useful in creating scoring opportunities.

Modern systems enable data to be entered using a computer. The mouse and a specially adapted keyboard are the most common means of entering data, although voice recognition may also be used. The developments in digital video recording have also enhanced the facilities for notation analysis. The material can be coded online and integrated quickly into an overall summary. Events during play can be highlighted and, if appropriate, extracts can be shown to the team or individual at half-time or after the game. The use of a time code allows immediate access to any specific time or action within the recording, allowing optimum use of player/coach time. Such an application underlinesthe potential forthe information extracted to be used in altering behaviour during the second half of the same game.

Charles Reep[11] was a pioneer of the Match Analysis methodology. In 1950s his observations had a great impact on football specific training and they showed for the first time a new professional profile: the Match Analyst.

At date many Universities and other Research Agencies such as the National/International Federation are dealing with Match or Performance Analysis in Team Sports. In these last years the systematic researches carried out mostly in Football environments gained a remarkable prestige, even in the academic world. Among others, scholars as Thomas Reilly (Liverpool – GB), Mike Hughes (Cardiff – GB) and Ian Franks (Vancouver – Canada) are providing a sound scientific background to this methodology in the framework of the Sport Sciences.

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[11] ***Charles Reep*** born (22 September 1904) in Cornwall. Charles Reep was credited for creating the long ball game which has characterized english football. Charles Reep trained as an accountant, Reep volunteered for the Royal Air Force in 1928. In the 1950s Charles Reep wrote his theories on football in the now defunct magazine *Match Analysis* from watching a variety of matches in soccer and concluded most goals were scored from less than three passes. So it was important to get the ball quickly forward as soon as possible.
The quicker the ball was played to goal with the least amount of pass the more goals would be scored but now know as the long ball but this theory has been since discredited. His ideas have been the foundation of the Norway national football team playing style.

2.3   Area of Applicability

Match Analysis finds its very true area of applicability in the so-called **"situation sports"**. As reported further on, this typology of Sports is particularly centred on the individual/collective ability to solve the current situations, determined by the game dynamics, through strategic plans and finalised tactical behaviours, learnt through specific practises and controlled by the availability of a vast range of motor skills. These skills may vary from the so-called "open skills" to the "semi-closed skills" (if related to very controlled and stabilised skills to be performed in particular situation even in team/fight sports: the *free kicks* and *corners* in Football, the *serve* in tennis or volleyball, the *short corner* in Hockey, the *free throw* in basketball, etc.).

In a broader sense, Match Analysis is linked to the process of acquiring data that pertain to the sport performance and its further processing. As shown in figure 4), the performance in sport is a complex structure that suggest manifold areas of investigations. Relevant analysis (Madella, 2007; Sacripanti 2007) ,may be performed about:

1. the **physiological domain** (Murphy, 2003; Spencer et al. 2005; Bonsignore and Ruscello, 2006)   and the **biomechanics** of the performed skills (Sacripanti,1989; Stuelken, 2003; Sacripanti, 2004; Camomilla et al. 2008), taken out from the real context of the game/match (the so-called "**pure technique**");

2. the "**competition invariants**" [12] and the **local strategies** (Reilly, 1993, 1997; Laird and Sutherland, 2003; Hughes and Franks, 2004; Sacripanti, 2007b; Ruscello et al., 2008);

3. the behaviours dictated by the **global strategies** or **the general tactics** (Kormelink and Seeverens, 1999; Sacripanti, 2007b)

Match Analysis processes are currently facing major evolutions and developments, and apparently, the new technologies are providing to the

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[12] We meant as a **Competition Invariant** a single game structure, stabilised and ruled, that cyclically recurs over a game or a match, often referred to the re-start phase of a match, following a game fault (free kicks, throw in, the serve, etc.)

analysts huge amounts of **raw data**, that need further **filtering, processing** and **interpretation.** Presenting the **outcome** of these processes in a convenient fashion, in order to be understood at various level, is a crucial part of this methodology (Darst, 1989; Madella, 2007; Ruscello; 2008a).

Match Analysis is based on acquiring, recording and processing the collected data during a systematic process of observation of the match event or of the training process, with the assumption of providing the **most objective information** of what is going on under effectively.

A crucial question is then pertaining the possible "client – user" of the Match Analysis process: is the Coach? Or a Player? Is a physiologist or a psychologist? What is aiming at with this line of research?

It is clear that analysing a complex performance such as a game or a match may provide so many opportunities of observation and infinite relationships among a multitude of variables, observed contemporarily or in later times.

To avoid the classic error of performing an **observation plan** just in order to collect as much information as possible, with the real risk of providing an *information overload,* (Madella, 2007) that could damage any real processing procedure of the gathered data, it is essential to design an **observational plan** that is aiming exactly at the dimensions of the performance identified as the significant ones. Generally speaking this plan must be able to answer to this general questions:

- What is the point for this Analysis and why?

- What data should I collect and how?

- Where this Analysis will be performed?

- What tools could I use?

- Will it be a Qualitative, Quantitative or Quali-Quantitative Analysis? (see fig. 8)

Qualitative analysis Area	Quali-Quantitative Analysis Area	Quantitative Analysis Area
Anedoptical Description of the performed skill/ tactical structure/Strategic al plan	A first integration of the Anedoptical Description of the observations with the numerical aspects or measures of the performance	Numerical Analysis of the observed events, measured with increasing degree of precision.

Figure 8 - Quantitative vs. Qualitative Analysis: the qualitative area is based on non numerical analysis of the observed event and on qualitative assessment of critical aspects of the performed skill. The quantitative area requires precise measurement of the performance.

- In which **temporal domain** should I go working with this analysis: **in the past time** (in order to classify events and for historical reasons), in the **present time** (in order to understand, to act and to react in the **real-time**) and even in the **future time**, in order to predict the **possible** behaviours of the players**,** on a statistical basis, and to plan specific interventions of improvement (on the fitness side, on the technical skills or on the tactical mastery).

Match Analysis: the possible applications in the time domain

1. Match Analysis in preparing the Match (Pre-Match)

2. Match Analysis during the Match (Real – Time)

3. Match Analysis after the Match (Post – Match)
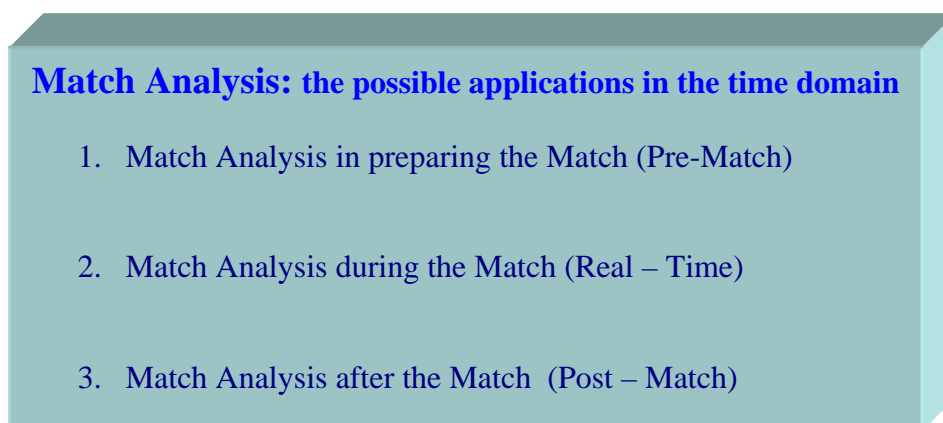
Figure 9 – When to perform a Match Analysis? Different temporal applications may require different abilities, tools and analysing methods.

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In this designing phase the emphasis should be set over the need of acquiring **objective information**, namely that complex of data that may be acquired only through accepted procedures of scientific and systematic observation, obtainable through adequately calibrate instruments and by specific personnel, conveniently trained, according to proved and reliable formative criteria (Darst, 1989; Donati et al., 1994; Reilly, 1993-1997).

Match Analysis refers to the **objective recording** and to the **assessment** of the behaviours performed during a competitive event, in a broader sense. This procedure may be focused on a single individual behaviour or it may include the integration of the actions of many players/athletes around the ball.

The Match Analysis process varies in **sophistication degree**:

1. it may provide information about a **single player/athlete**, both of the own team or of the opponent's one, in order to offer an **individual profile**;
2. it may provide information of **all the players involved**, both of the own team or of the opponent's one;
3. it may provide information about the **relevant interactions** occurring among the involved players **during a Match or a series of Matches.**

The behaviour of a team during an offensive or defensive phase may be analysed, and people may require even to analyse contemporarily the behaviours of both the teams (Reilly, 1993, 1997).

Thanks to this procedure of Analysis, further possible outcomes may be that ones of describing possible **team patterns** (Jonsson et al., 2001; McLaughin et al., 2001), namely structures of play that repeat similarly over the time and space of the game (time motion analysis; positional analysis; temporal patterns; etc.).

Modern Match Analysis procedures represent a strong point in Sport Pedagogy (Madella, 2007), with a vast range of intervention, that may be summarised as follows in table 2) and 3).

a) Qualitative and Quantitative Descriptions of events, typical or probable course of actions.

b) Identification of the performance's critical phases and actions.

c) Scientific knowledge – comparing teams/athletes – development of the systems of the game.

d) Defining the winner profiles (teams or individuals), compared to the losers' ones. Forecasting the possible optimal outcomes

e) Providing knowledge suitable for training purposes in the coaches' education processes.

f) Checking of the Coaches' subjective perceptions.

g) Calculation of efficacy indexes – Individual/Team.

h) Generation of archives/databases.

i) Identification of the development/training objectives.

j) Designing training methods

k) Specific Fitness Training (internal-external loads; conditioning training practises).

l) Psychological Preparation

Table 2 – Match Analysis – Possible Aims and Areas of Applicability (Madella, A., 2007)

a) There is not enough knowledge on how and how much coaches use Match Analysis.

b) The Cultural Delay: sophisticated Technologies for rather traditional information and use.

c) Data Processing is often very simplicistic (descriptive statistics only) and all the possible tools of Data Analysis are not fully exploited.

d) Information overload and cultural gap.

e) Relationship with the relevant training data.

f) Risking the Oversimplification of the factors forecasting success.

g) It cannot necessarily solve all the bias of the natural observation processes, rather it can increase them, acting as a "false frendly tool".

h) Issues related to Power/Politics (coach confirmation, players' leadership, players' hostile reactions, etc.)

Table 3 – Current Match Analysis' Limiting Factors (Madella A.; 2007)

2.3.1.   Motion Analysis and the Technical-Tactical Skills

While analysing and assessing sport performances, one must take into great consideration, beside the physiological profile, the impact given to the performances by the specific technical and technical-tactical components (Hughes and Franks, 2004; Sacripanti, 2007a e 2007b, Madella, 2007, Camomilla et al., 2008; Ruscello, 2008a).

Generally speaking, in Team Sports, these components comprise:

1. the contact with the ball (receiving, intercepting, etc.)
2. controlling/handling the ball (dribbling, passing, shooting, etc.)
3. defending/dispossessing (marking, tackling, pressing, etc.)

It has been computed that in Football and in Field Hockey, less than the 2% of the total distance performed by a player during a match happens while he/she is carrying or dribbling a ball. Thus in these sports, the vaster majority of the actions realised by a player are performed *off the ball*, both by running to create space and/or to support a team mate leading the ball or by running to chase and close down an opponent, to regain possession or to close the crucial space of the game.

The whole energetic expenditure, therefore the physiological demand, varies depending on the level of the competition, the style of play, the positional role and environmental factors. For example at international level, the technical and tactical demands of a match are often higher than those demanded at national/domestic level. On the contrary it is not unusual finding a greater aerobic power in athletes playing competitions held at national level.

These differences may have direct consequences on the individual training profile of a player, and they have to be carefully analysed while designing the specific training programmes.

Finally, analysis methodologies of energy expenditure, based on Motion Analysis, are based on the principle that the locomotion energy cost over a certain distance is directly correlated to the observed mechanical work and it is largely dependent on the execution velocity.

Individual work-rate may be synthetically indicated by the total distance covered during a match. Total distance covered may represent even the whole intensity exerted and the individual contribution to the collective effort made by a team too.

Work intensity may be coded as follows:

1. standing
2. walking
3. jogging
4. spurting
5. sprinting.
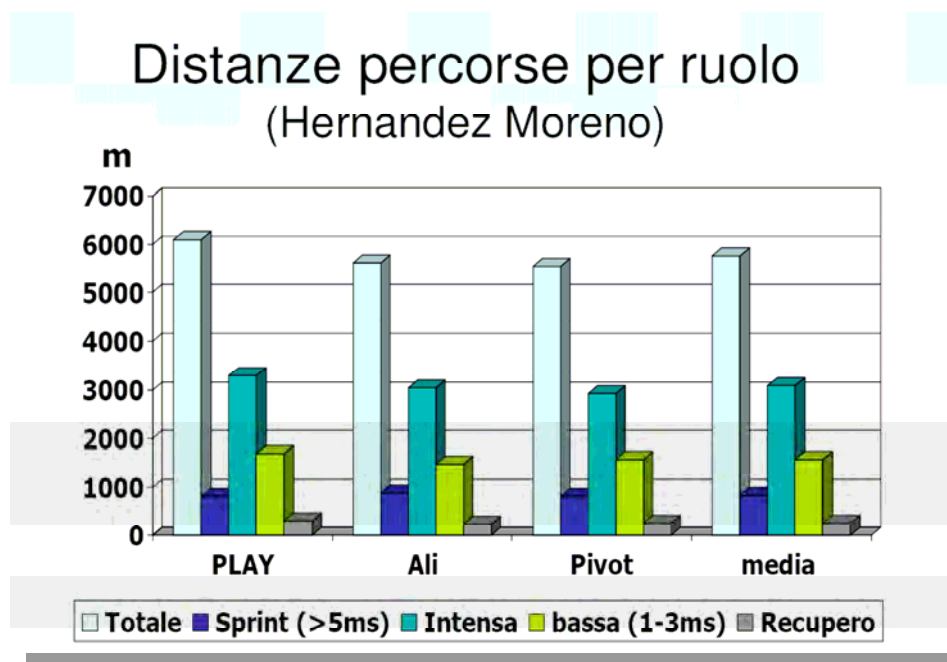
Figure 10 – Motion Analysis in Team Sport (Basketball)

Jumping, tackling, dribbling or leading a ball, moving aside or changing direction, running over a curve line or backwards represent other activities that have to be recorded in order to provide a precise and accurate Motion Analysis. High/low intensity work ratio may be computed, since this indicator shows synthetically the **density** of the "**qualitative stimulus**" during a game or a match, in order to verify the **intermittence** of the **high intensity work phases** and the average resting phase occurring, depending on the typology of the match, the positional role, the style of play, etc.

In 1984 Ruscello[13] proposed a software that was designed in order to make some basic statistics during an ongoing Match. It worked as a tool able to support the observations carried out by the Assistant Coaches, following some specific observational plans agreed with the Head Coach before the game.

Some examples are provided :
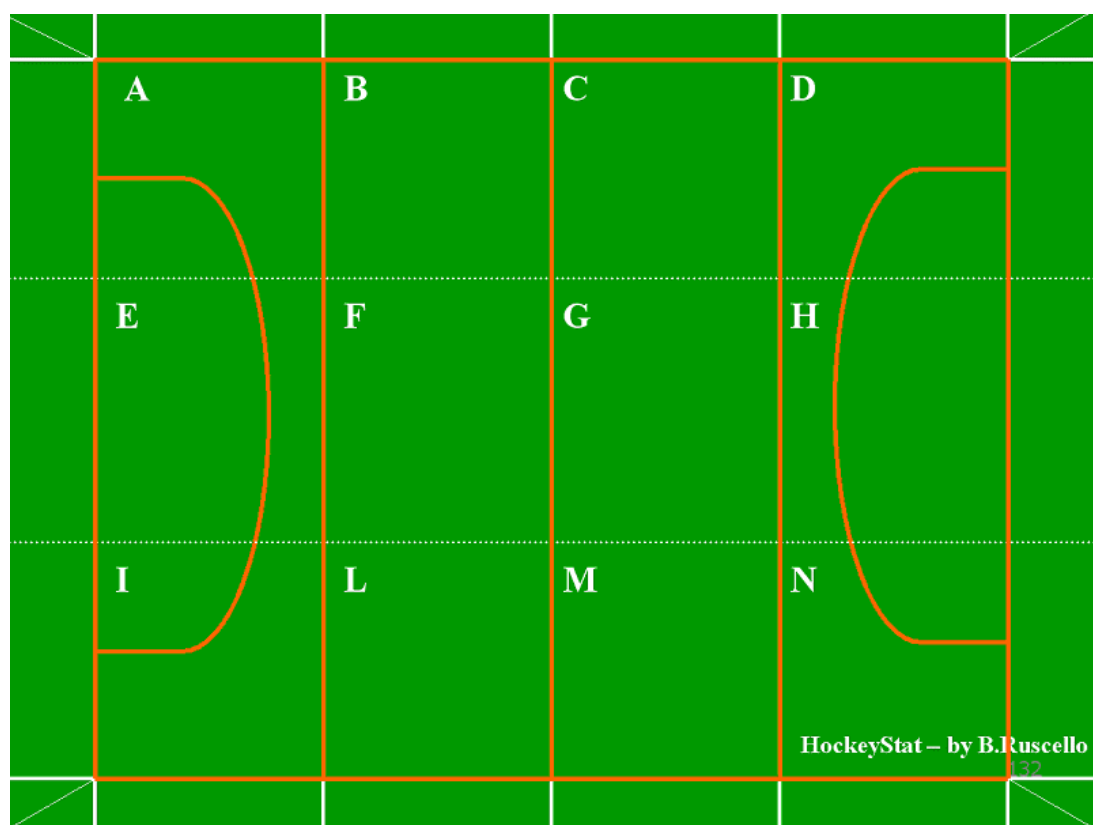
Figure 10   - HockeyStat (Ruscello, 1984)

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[13] Ruscello B., (1984) "HockeyStat - Appunti di Match Analisi per Allenatori"; Federazione Italiana Hockey – CONI -Roma
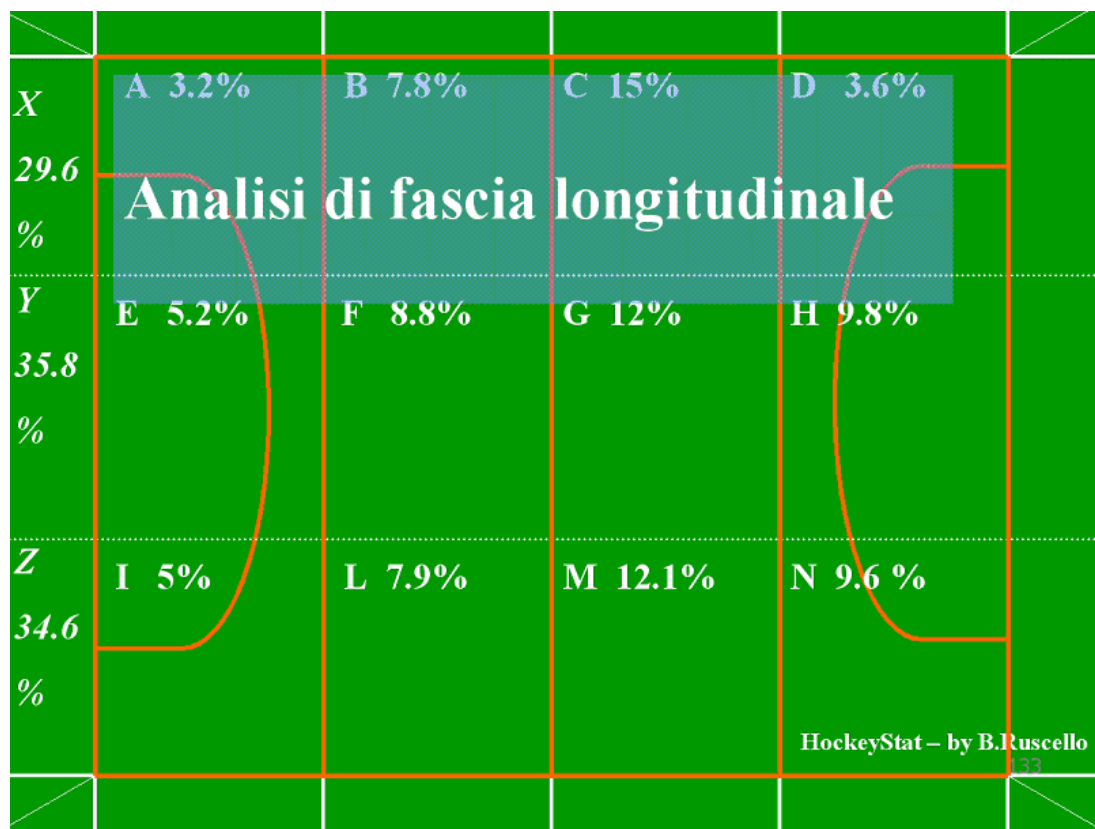
Figure 11 - HockeyStat: Analysing the Flank close to the Lines (Ruscello, 1984)
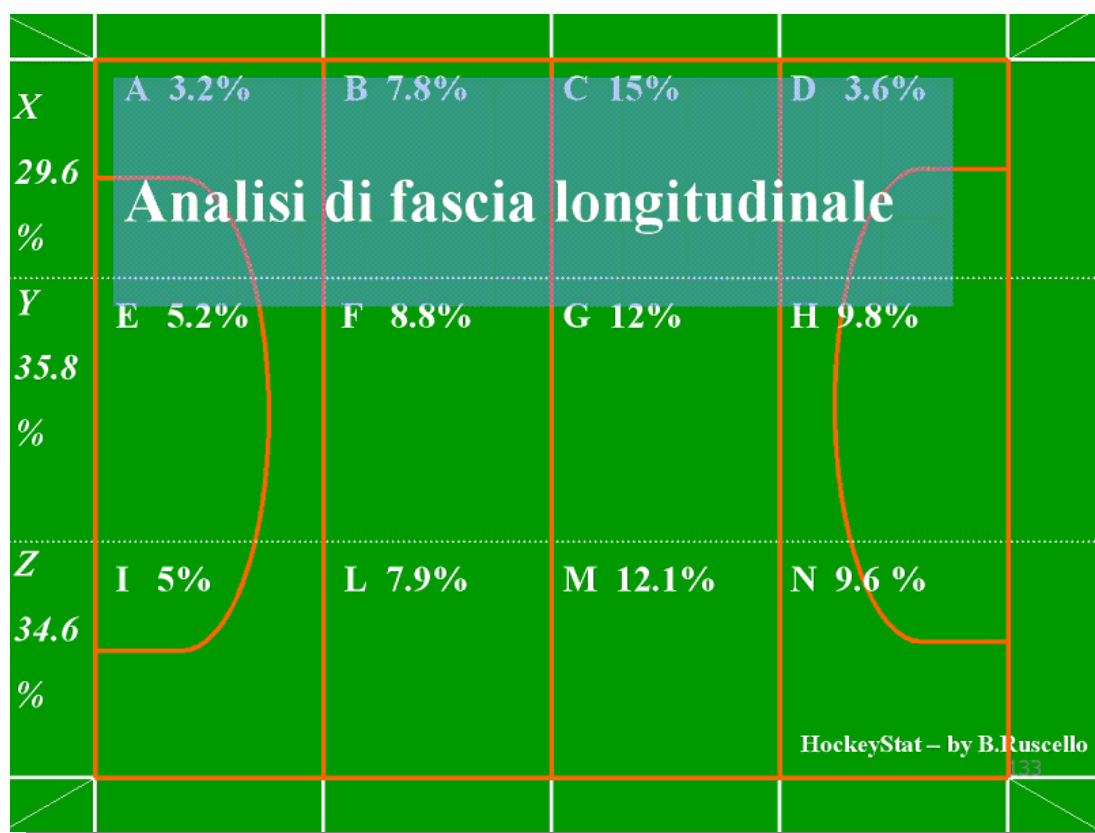
Figure 12 – HockeyStat: Analysing the Central Zone of the pitch (Ruscello, 1984)

In 1990s Ruscello and Iaccarino[14] proposed a first software designed in order to reckon and possibly measure the **Total Distance** performed by Italian Hockey Players, competing at international level.

Some outcomes of these researches are provided as follows:
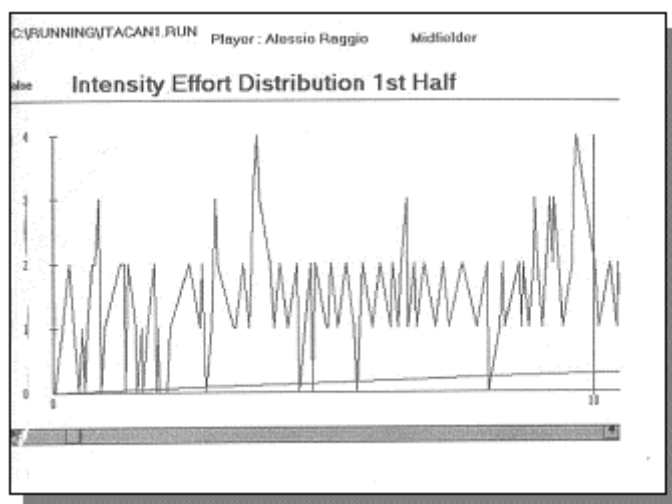
Figure 13 – "Motion Analysis in Hockey". (Ruscello-Iaccarino, 1995)
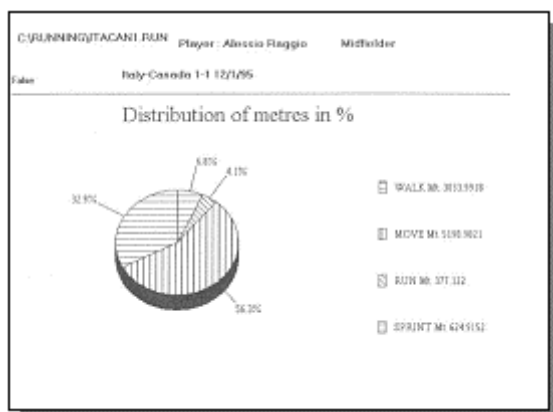
Figure 14 - "Motion Analysis in Hockey: distribution of distances covered - %" . (Ruscello-Iaccarino, 1995)

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[14] B.Ruscello, G. Iaccarino; (1995); "Motion Analysis in Hockey"; Federazione Italiana Hockey – CONI -Roma
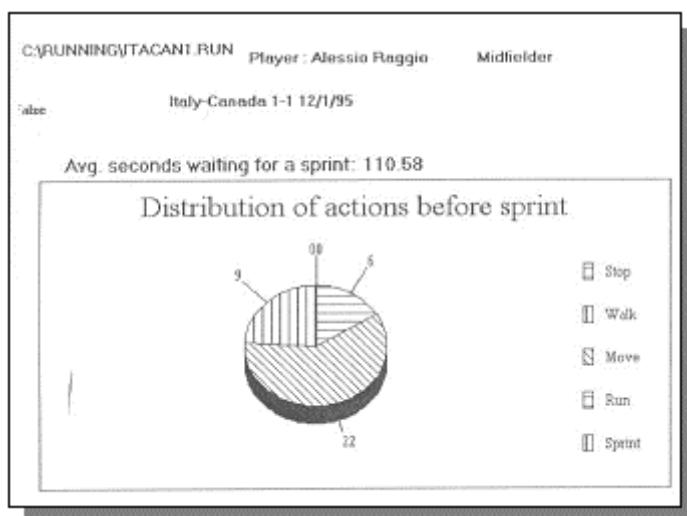
Figure 15 - "Motion Analysis in Hockey: distribution of actions before sprinting – Intermittence Work Analysis" (Ruscello-Iaccarino, 1995)

Figure 16 - "Motion Analysis in Hockey: total distances distribution" (Ruscello-Iaccarino, 1995)

2.5. Conclusions

To conclude this introductory chapter to the Match Analysis procedures, we are going to give a general overview of what could be the general aims of this methodology, whose deeper understanding is an important part of this thesis.

Match Analysis in Team Sports (Sacripanti, 2007a; Sacripanti, 2007b) is principally aimed at:

1. automatically identifying the **physiological demands** in competing players, directly or indirectly, in order to use these data to correctly model the proper fitness training programme **(Training Level One)**.

2. automatically obtaining information about:
   - the biomechanics of the specific technique performed by an individual player;
   - some data on specific situations, based on statistics and frequencies, that cyclically repeat over the match (**Performance Invariants**). Those situations have to be trained properly during the "*acquiring phase of training*" through appropriate drills that may effectively contribute to significantly improve the player's mastery in managing these aspect of the game. **(Training Level Two)**

3. obtaining from Automatic Trajectories Tracking Systems, information on:
   - the recurring transition phases, that we may call "**Local Situation Strategies**" (attacking, counter attacking, defending, keeping an advantage situation, recovering from disadvantage, ecc.);
   - the whole motion of a Team in relation to the other one, that we may call **"Global Situation Strategies"**. Both of them, the **Local Strategies** and the **Global** ones have to be properly **analysed** and **trained**, in order to ensure the maximum efficacy during the Match. **(Training Level Three).**

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Chapter 3

Sports Classifications

3.   Sports Classifications

Each attempt of sports classifying is perplexed by the fact that a single athletic discipline may belong to several categories in the same time, depending on the chosen criteria of classification or typology.

Indeed it is only for convenience reason that six categories of sports are recognised in a quite known classification adopted in the world of Sport Sciences:

1. Athletic Disciplines, such as track and field, gymnastic, weight-lifting, swimming, cycling, etc.;
2. Combat Sports, such as boxing, wrestling, fencing, judo, karate and other martial arts;
3. Ball Games, such as football, rugby, basketball, handball, volleyball, tennis, table-tennis, hockey, etc.
4. Motoring Sports, such as Motoring or Motorcycling
5. Sliding Sports, such as Alpine and Nordic Skiing, Ice and Roller Skating, Bob, etc.
6. Nautical Sports, such as sailing, water skiing, etc.

In the last decades new disciplines were born and got popularity: beach volley, mountain bike and snowboarding are already enclosed in the Olympic programme.

Many are then the physical activities that are set between sport and adventure, such as scuba diving, mountain climbing, hand gliding or parachuting or other physical activities set between sport and skill games, such as bowling or billiards.

3.1   Dal Monte's Sports Classification

According to professor Dal Monte[1], any classification must be founded upon three necessary requirements in order to be useful for pragmatic or experimental purposes:

It might be able to detect the predominant functional strain over the different utilised organs and apparatuses, while performing a specific discipline through its peculiar skills;

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[1] Dal Monte A.; "Fisiologia e Medicina dello Sport" 1977, Sansoni Ed. - Firenze

It might be able to define, even in an indicative/qualitative shape, the sectorial involvement of the muscles, namely the intensity degree of the muscle contractions and the percentage of the engaged muscle mass.

It might be able to provide to physiologists a clear definition and a taxonomy of the specific requirements, suitable to perform correctly and at the best possible level the investigated discipline, in order to proper evaluate the individual attitude and efficiency.

Based upon these criteria, sport activities might be classified, according to professor Dal Monte, as follows:

- Prevalently Anaerobic Activities
- Massive Aerobic/Anaerobic Activities
- Prevalently Aerobic Activities
- Alternating Aerobic/Anaerobic Activities
- Power Activities
- Skills-based Activities

Thus these guidelines could be used, keeping in mind that we can consider as valid the inverse proportion relationship between the percentage of the involved muscle mass and the intensity of the applied power.

Prevalently Anaerobic Activities encompass the athletic disciplines having an overall duration between twenty (20") and up to forty-five (45") seconds. In this category we can find those activities that show the maximal requirements to the human body in order to grant to the locomotion apparatus the maximal quantity of available energy, as in:

- Sports with a higher percentage of engaged muscle mass.
- Sports with an average percentage of engaged muscle mass.

Massive Aerobic/Anaerobic Activities encompass the athletic disciplines having an overall duration between forty (40") and up to four-five (4-5') minutes. Activities whose movements require both a higher power of the cardiac-respiratory apparatus and a big capacity of anaerobic work belong to this group of sports. Athletic disciplines included in this group may greatly vary from each other, as in:

- Sports with a high percentage of engaged muscle mass and limited sectorial involvement of the muscles.
- Sports with an average percentage of engaged muscle mass and a medium level sectorial involvement of the muscles.
- Sports with a reduced percentage of engaged muscle mass and a high level sectorial involvement of the muscles.

Prevalently Aerobic Activities encompass the athletic disciplines having an overall duration longer than four (4') minutes. Activities whose movements require, for most of the performance, aerobic energy. This group of sports includes activities that considerable vary from each other so, keeping in mind the validity of the inverse proportion relationship between the percentage of the involved muscle mass and the intensity of the applied power, we can state that the greater is the quantity of the involved muscle mass, the lower will be the power and shorter the time required to perform.

Alternating Aerobic/Anaerobic Activities encompass the athletic disciplines based upon a quasi-regular alternation of sub-aerobic, aerobic, anaerobic and resting phases (e.g. Team Sports).

Power Activities encompass all the athletic disciplines that require the ability of greatly accelerate and propell different masses, such as in shot put or the self-body as in long jump.
Usually in this group of activities, the lactic acid intervention is limited while the aerobic energy is involved at the end of the performance, in order to pay the lactic acid debt.

Skills-based activities encompass all the athletic disciplines that require a high level of psycho-sensorial and neuro-muscular coordination and, in certain cases, a high level of muscular work capacity.

3.2   Manno's Sports Classification

Another useful sports classification is the one proposed by Manno[2], that considered almost all the sports activities currently recognised:

Performance Sports	Power and Sprint Sports Endurance Sports
Situation Sports	Ball Game Team Sports Ball Game Individual Sports Fighting or Combat Sports
Skill or Artistic Sports	Athletic Disciplines qualitatively evaluated by Judges or Referees
Aiming-Shooting Sports	With mobile or fixed targets

For example in the **Power and Sprint Sports** we find: Weightlifting, Jumping, Throwing and Sprinting in Track and Field, Sprinting in Indoor Cycling, etc.
In **Endurance Sports** we find Running (long and middle distances) in Track and Field, Swimming, Outdoor Cycling, Nordic Skiing, Canoeing, Rowing, etc.

Situation Sports are based on unpredictability of the game/match situations, due to the opponents trying to hide their real purposes, through individual or team feints. If in **Performance Sports** the rules try to keep as steady as possible any standard situation, in **Situation Sports** the aim of those disciplines is not to replay the same situation in the same way. In this group of Sports sensor-perceptive features, individual skills and tactic knowledge are crucial. Collective forms of sports may vary remarkably from the individual and fighting ones. **Ball Game Team Sports** are: Football, Rugby, Basketball, Volleyball, Hockey, Handball, etc. **Ball Game Individual Sports** are: Tennis, Table-Tennis, Badminton, etc.
Fighting or Combat Sports are: Judo, Karate, Boxing, Wrestling, Fencing, etc.
Skill-based or Artistic Sports competitions are based upon the aesthetic results obtained by performances executed with the highest degree of precision, balance

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[2] Manno, R.; "Fondamenti dell'Allenamento Sportivo"; 1989; Zanichelli ed.; Bologna

and harmony. The environmental conditions of the performance are highly standardized. The Judges role influences heavily the outcome and presents many subjective elements. **Skill-based or Artistic Sports are:** Gymnastics, Figure Ice or Roller Skating, Diving, etc.

3.3   D'Jacov and Farfel's Sports Classification

This is a very popular Sports Classification, used for several years by the insiders, as a good and appreciated synthesis, based upon the specific features of the applied technique while performing.

Sports Classes	Type of Sport	Common and General Aims of the Technique
Maximal Strength Sports Power Sports Sprint Sports	Weightlifting Jumping and Throwing in Track and Field. Short Distances in Running, Skating, Cycling	Exploitation of each characteristic of the motion in order to evoke the maximal aspect of strength, power and speed
Endurance Cyclic Sports	Walking, Running, Skating, Cycling, Nordic Skiing, Rowing, Canoeing, nuoto	Seeking for the maximal economy and efficiency of the movements
Precision or Aiming Sports	Shooting, Archery, Bowling	Seeking for the maximal precision of the movement
Skill or Artistic Sports with qualitative assessment	Gymnastics, Rhythmic, Figure Skating, Diving, Synchronized Swimming, Water Ski, etc.	Seeking for the maximal evaluation from the Judges Panels, through performances more and more difficult, precise, spectacular, etc.
Situation Sports: Team Sports Fighting or Combat Sports Sports with a fast environmental adaptation:	Football, Basketball, Volleyball, Handball, Tennis, Water polo, Baseball, Rugby, Hockey, etc. Wrestling, Boxing, Fencing, Judo, Karate, ecc. Alpine Skiing, Fluvial Canoeing, Bob, Orienteering, Motocross, etc.	Optimal and Fast Adapting to technical and tactical situations in order to disorganise as more as possible the opponents skills, keeping safe and efficient the own one. Keeping an optimal technical level, regardless of mutable environmental conditions.

Table 1 (Sports Classification according D'Jakov e Farfel)

In **Maximal Strength Sports** the principal aim is that one of developing and acquiring a technical skill suitable to reach the individual highest strength level, in order to cope with the greatest resistances (weightlifting).

In **Power Sports** is important to reach the highest peaks of power during the principal phase of the movement, in order to exploit the best acceleration trajectories and the best exit angles so to propel the sport devices (e.g. throwing) or the self-body of the athletes (e.g. Jumping).

Also in **Sprints Sports** is important to perform skills able to produce the highest level of power in the smallest time. Very often a **specific skill,** able to keep the optimal balance between power and velocity is required (sprinting in track and field or in cycling), or between speed and precision (as in fencing) or the three all as in boxing.

Under a **biomechanical** point of view, all this sports skills have the same aim: maximize the outcome of the motor abilities related to the contractile functions of the muscles (maximal strength, power, speed).

In **Endurance Sports** the aims of the technique are quite different. In these cases both the athlete and the coach are seeking for the more economic gesture in order to avoid fatigue and to keep enough energy for the closing phase of the competitive event.

In such sports, prevalently cyclics, the fitness conditioning has got the aim of incrementing the power of the locomotor apparatus, whereas the skill training has the aim of improving the performance output or yeld, keeping the overall performance **energy expenditure** within acceptable limits, in order to reach the best prolonged performance.

If in Maximal Strength or in Power Sports the principal aim of the technique is improving "the engine", in Endurance Sports the aim is increasing the whole efficiency of the human machine, so any technical skill has to be trained and performed in order to achieve the maximal biomechanical "rendering", in relation to the energy expenditure.

All the above-mentioned issues tend to become secondary in a vast range of athletic disciplines, varying from the **skill-based sports** to the **precision sports** and up to the **situation sports,** whereas the aims of the applied techniques or specific skills are completely different.

The principal aim of performing the technique, in **skill-based sports with a qualitative assessment**, is that one of being able to impress the Judges or the Referees, in order to receive the greatest appreciation and obtain the best score as possible. This is why, in these sports, coaches and athletes are always looking for new difficulties and new skills. Obviously these skills, according to the specific norms ruling the sport, have to be performed as precisely as possible and must have an expressive and choreographic content suitable to favourable impress the Judges Panel.

In **Precision Sports** the principal aim of the technique is to hit the target as more precisely as possible, making the smaller amount of mistakes throughout the competition. It is not important to perform with the maximal expression of strength or speed or to reach the best energy expenditure or to show more and more complicated and new skills, but it is essential to be able to link information and movement in order to perform extremely precise skills (bowling, golf) or even to minimize any not required movement of the body or of a part of it, such as in shooting or archery.

In **Situation Sports (team sports, fighting sports or fast adaptive sports)** the technique has a so complex and variable function that is really hard to define it by a single term.

In these sports it is fundamental to correctly perform movements in conditions that continuously change, in relation to the always-variable agonistic situations. The required specific skills are termed as **"open skills"**, since the ones required in other classes of sports, such as **power** or **skills-based sports**, are defined as **"closed skills"**, meaning the higher standardised level of performance required.

In **team and in fighting sports** it is crucial to plan and to develop the competitive actions in such a way that it is possible to anticipate and to "predict" the opponent's moves, both in defence or in attack. In the meanwhile the aim is to make the opponent understand as later as possible the real intentions of the athlete/player, in order to surprise him. In other words the opposing technique needs to be disorganized in order to keep efficient the one's own. Ones must bear in mind that many situation sports require movements with a high level of precision (passing in team sports, stabs in fencing, etc.) or of speed and power (serves or shooting, hits in boxing, etc.). It also important to combine the movements in quick successions, often very fast as well as variable. Other

movements require a big effort and involve maximal strength (wrestling or rugby) and in many situations it is also important to perform in an economical way, since the final result could be influenced by the energy saved at the end of the game. Thus in **situation sports** the technique of many specific skills may present similar aims to the ones seen previously, but the main problem is still that one of adjusting it while coping with the ever changing situations. As a consequence of that, strength, precision and other features of the performance capacity are heavily affected by the "**situation factor**" that makes these sports through and through peculiar.

In **Sports with a fast environmental adaptation** (alpine skiing, mountain biking) more than the opponent ones must cope with the variability of the environmental situation that could happen in a less predictable and very quick way.

3.4   Verchoshanskij's Sports Classification

A very interesting and useful Sports Classification is that one proposed by Jury Verchoshanskij, particularly referred to the issue of *skills mastering* in different athletic disciplines[3].

He put forward a specific **sports classification** seen in the process context of motor learning and skills development of Sports Techniques, at maximal levels, linking this process to the Physical Special Training, a vastly investigated issue by this author.

According to the required specific sport skill mastery, we may subdivide the athletic disciplines in different sub-groups, where the Physical Special Training process suggests common features, as follows:

1. Sports demanding **a high single muscle strength engagement.**

2. Sports demanding the **exact dosage of muscle power and the spatial precision of the movements.**

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[3] Verchoshanskij J.; 2001; "Introduzione alla Teoria e Metodologia dell'Allenamento Sportivo"; CONI-SDS, Roma

3. Sports with **alternating contest conditions, requiring a specific endurance.**

4. Sports with a **cyclic structure of movements, requiring endurance development.**

Sports demanding high single muscle strength engagement.

The principal characteristic of these athletic disciplines consists of the athlete's ability of performing a single powerful and concentrated strength engagement, during the sport action main phase. We refer to it as an **Impulse**[4].

Essentially this ability is based on the formation of a steady and resistant to perturbations biodynamic movements structure. As the skills mastery improves over time, thus improving the specific techniques, so does this biodynamic structure.

As a matter of fact it is well known that as the percentage of power directly destined to realize the required motor task increases, the percentage of inhibitory forces decreases (inter-muscular coordination).

In the resulting motor action kinematics, we can underline a larger range of motion and movements' speed and a more rational spatial-temporal coordination.

Hence in those **Sports demanding a high single muscle strength engagement** (e.g. jumping or throwing in track and field) the sport mastery is represented by the athlete's ability of completely exploiting his/her muscle potential in the shortest period of time.

Improving fast strength and power is the key factor in specific skills mastering.

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[4] Impulse is defined as the integral of a force with respect to time

$$d\vec{I} = \vec{F}dt$$

or:

$$\vec{I} = \int \vec{F}dt$$

Where the unit of measurement is N * s (Newton x second).

Sports demanding the exact dosage of muscle power and the spatial precision of the movements.

The principal characteristic of these athletic disciplines consists of upper level coordination ability in strength engagements, in order to solve the assigned motor task.

According to Verchoshanskij, in order to ensure the sport mastery improvement in these disciplines (e.g. Gymnastics, Diving, etc.) we need to create a sort of "power reserve" of the individual motor potential, namely developing the motor abilities up to a degree that is higher than that needed just to perform. It should ensure variability in performances, without the risks of an exhaustion of the athlete's motor potential.

Sports with alternating contest conditions, requiring a specific endurance.

This sub-group of athletic disciplines encompasses Fighting Sports, Team Sports and Sports with Multiple Events, such as Decathlon or Pentathlon.

These disciplines are characterized by a vast range of complex motor actions, which require a high level of explosive power and the capacity of fast adaptations to the alternating contests of the event or match.

Moreover a high level of a specific endurance also characterizes them (e.g. Repeated Sprint Ability in Team Sports) in order to avoid fatigue and keep steady the ability to solve problems under pressure.

Sports with a cyclic structure of movements, requiring endurance development.

These athletic disciplines (long distance Running, Nordic skiing, Cycling, etc.) are performed by repeating, time after time, several cycles of stereotyped movements, which do not require particularly intense muscle power engagement. However, behind this apparent simplicity of the cyclic locomotion kinematics, we can find a really complex biodynamic structure, rationally designed.

The common motor task of all the sports with a cyclic structure of movements is that one of moving as fast as possible over the given distance and doing it

in the shortest time. Thus the technical mastery in these athletic disciplines is determined by several factors, such as:

- Strength capacity.
- Efficiency.
- Body Energy Saving.
- Fast recovering ability.

The Body Energy Saving is the main characteristic in cyclic sports master ability. For example in a standardise work, high level Ice Skaters have a smaller oxygen consumption and, as the sport mastery and the oxygen consumption improve, the utilisation percentage of the aerobic capacities decreases.

Moreover it is well known that with the improving of the level of training, in human locomotion at set velocity, the ratio between movements frequency and their amplitude changes. High-level athletes perform with greater amplitude of movements (strides, strokes, etc.), but with a lower frequency, representing another confirmation of the saving energy phenomenon.

The so-called "energy distribution over the event distance" (or "distance tactic") is a major issue referring to a rational and economical energy expenditure. It is well known that running at a consistent velocity (with no changing pace or rhythm) is much more affordable than running with such variations. In high-level athletes, variation in speed from 6 to 6.5 m/s indeed represents a major changing in body energy production.

At date the major competitions over long distances are characterized by:

- Changing the pace (in frequency of movements);
- Changing and alternating the rhythm, over long periods of the competition;
- "Long Sprinting" in the last phase of the competition (the "closing").

Thus, even in these athletic disciplines the term "tactic" has a precise meaning.

3.5   Other Sports Classifications

Different classifications pertain to other aspects of the sports performances, grouping them under different points of view, and they could be very useful to the work of a Match Analyst, since they can provide interesting approaches or lines of researches.

For example the following is a Sports Classification based on the energy expenditures of different athletic disciplines and giving some advices under the nutritional point of view.

lassification	Class	Duration	Energy	Athletic Discipline	Diet typology
Short Duration Sports Without pre-competitive feeding	Strenght Sports	Up to 10 sec.	Anaerobic without lactic acid production	• Weightlifting • Javelin Throw • Hammer Throw • 100 m. • 110 m. hurdles	Proteins 22-25% Fats 33-36% Glucoses 42%
		From 10 up to 40 sec.	Prevalently Anaerobic with lactic acid production	• Running 200 – m. • Indoor Cycling Sprint • High Jump • Long Jump	
	Power and Speed Sports	From 40 sec. up to 4 – 5 min.	Alternating Anaerobic and Aerobic	• Alpine Skiing • Swimming: 100-200 m. • Track and Field: 400m Hurdles • 800-1500 m. • Gymnastics • Cycling - chase • Rowing: 1000 m. • Canoeing – kajaking (Short distances) • Pentathlon moderno	Proteins 18% Fats 30% Glucoses 52%
Medium Duration Sports With pre-competitive feeding and energy recharge	Fighting Sports Team Sports Individual Game Sports	More than 10 min.	Alternating Anaerobic and Aerobic	• Wrestling – Judo – Karate • Kung fu – Boxing • Taek won do • Tennis – Football – Polo • Soccer • Hockey – Basketball • Volleyball – Water Polo • Handball – Rugby • Cycling (indoor - 4 km) • Cycling (100km)	Proteins 15-20% Fats 25% Glucoses 55-60%
Long Duration Sports With pre-competitive feeding and energy recharge during the competitions	Endurance Sport	Prolonged	Prevalently aerobic	• Track and Field: • Long/Middle distances • Marathon • Canoeing/Kayak over long dist. • Rowing over long dist. • Cycling • Skating • Swimming • Nordic Skiing • Triathlon	Proteins 15-17% Fats 25-27% Glucoses 56-60%
Gym or Indoor Sports	Strenght, Power, Endurance Sports	Variable	Aerobic and anaerobic	• Fitness • Aerobics	Proteins 20-25% Fats 10-15% Glucoses 60-65%
		Variable	Prevalently anaerobic	• Body building	Proteins 28-33% Fats 12-17% Glucoses 50%

This is an interesting sports and work classification, grouping together athletic disciplines referring to the energy expenditure, defined in MET[5] per hour.
 I

Sleeping (1 MET)

Light physical activities (1 MET- 2.9 MET)

Sitting
Lying down

Moderate physical activities (3 MET- 4.9 MET)

Walking at 5-6 Km/hr.
Gardening
Golf
Sailing
Table-Tennis (not competitive)
Snorkeling
Horse-riding

Heavy physical activities (5 MET-7 MET)

Aerobic Dancing
Competitive Dancing
Cycling
Trekking
Scuba Diving
Ice or Roller Skating
Water Ski
Swimming

Very heavy physical activities (> 7 MET)

Team Sport: Basket, Football, Hockey, Rugby, etc.
Tennis
Ski
Fast Running
Fast Swimming
Rowing, Canoeing, etc.
Competitive Cycling

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[5] 1 MET is equivalent to the energy that an individual consumes for each kg. of Body Weight (BW) per hour, while resting. Usually an individual consumes 1 Calorie per hour per Kg. of B.W., thus a person weighing 70 kg. will consume in 1 hour 70 Calories (1 MET).

SPORTS CLASSIFICATION REFERRING TO CARDIOVASCULAR ENGAGEMENT[6]:

- Not Competitive Sports with minimal/moderate engagement
- Sports with "neurogenetic" engagement
- Sports with "blood-pressure" engagement
- Sports with medium/heavy engagement
- Sports with very heavy engagement

NOT COMPETITIVE SPORTS WITH MINIMAL/MODERATE ENGAGEMENT

They are characterized by a constant rhythmical hearth activity and sub-maximal frequency.

Walking, Nordic Skiing, Footing, Jogging, Cycling, Swimming, Canoeing, Trekking

SPORTS WITH "NEUROGENETIC" ENGAGEMENT

They are characterized by the cardiac frequency (CF) increase more than the Cardiac Output, due to the competition with a high emotional impact.

1. ***With medium-high increase of CF***
   Parachuting, Motor Biking, Motoring, Competitive Aviation, Scuba Diving, Speedboat Racing, Horse Riding, Polo, Diving

2. ***With minimal increase of CF***
   Golf, Bowling, Fishing, Shooting

- **SPORTS WITH "BLOOD-PRESSURE" ENGAGEMENT**

They are characterized by:

- Not maximal Cardiac Output (CO)
- Cardiac Frequency (CF) ranging from high to maximal
- Vascular Peripheral Resistances ranging from medium to high

Track and Field: Sprinting, Jumping, Throwing; Cycling (Sprint); Skating (Sprint); Weightlifting, Alpine Skiing, Water Skiing, Windsurfing, Table Tennis, Motocross, Climbing, Free climbing, Synchro, Body building

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[6] *(from: "Protocolli cardiologici per il giudizio di idoneità allo sport agonistico 1995")*

SPORTS WITH MEDIUM/HEAVY CARDIO-VASCULAR ENGAGEMENT

They are characterized by:

- Maximal Cardiac Output (CO)
- Cardiac Frequency (CF) ranging from high to maximal
- Vascular Peripheral Resistances ranging from high to maximal

Football, Indoor Football, American Football, Rugby, Basketball, Volleyball, Beach Volley, Handball, Water Polo, Canoeing, Fighting Sports, Gymnastics, Fencing, Boxing,Figure Skating, Baseball, Hockey, Tennis, Squash

SPORTS WITH VERY HEAVY CARDIO-VASCULAR ENGAGEMENT

They are characterized by:

- Maximal Cardiac Output (CO)
- Maximal Cardiac Frequency (CF)
- Maximal Vascular Peripheral Resistances
-

- *Track and Field (from 400 m. up to the Marathon)*
- *Canoeing (from 500 m. on)*
- *Rowing*
- *Cycling (chasing, MTB,)*
- *Swimming (from 100 m. on)*
- *Ice Skating (from 500 m. up to 10.000 m.)*
- *Roller Skating (from 500 m. up to 20.000 m.)*
- *Alpine Skiing*
- *Nordic Skiing (from 15 up to 50 km)*
- *Biathlon, Triathlon*

3.6 A Biomechanical Sports Classification

There are several sports classifications:

1. Referring to the energetic expenditure (physiological and biomechanical classification, Dal Monte A., 1983)
2. Referring to the complexity of the motion (physical and biomechanical classification)

3.   Referring to the kind of motion needed to perform:

- Cyclic Sports (with a basic repeated motion): namely those ones whose performances are essentially based on a specific cyclic motion or movement repeated over time, thus the performance could be investigated through the analysis of these particular repeated motion or movement.

- Not Cyclic or Acyclic Sports (the basic movement is performed just once): namely those ones whose performances are strictly related to a specific movement or gesture, performed just once; motions and performances could be investigated through the analysis of these specific motions or movements.

- Alternated-Cyclic Sports (several basic repeated and alternated motions or movements): namely those ones whose performances are defined by two or more basic motions or gestures, repeated alternatively over time, so that performances could be analysed investigating individually each motion or gesture, thanks to the theorem of the independence of simultaneous actions.

- Situational or Contest Sports (movements without repeatability patterns): namely those ones whose performances are not characterized by simple and repetitive temporal patterns of the performed movements, due to the presence of one ore more opponents. So there is no a fixed pattern over time and the theorem of independence of simultaneous actions may not be applied. These sports may not be investigated through the analysis of summed or linked simple actions, because of the presence of opponent/s who tries/try to counteract the performed skills, and makes the ongoing situation not repeatable, but classifiable only statistically speaking. Therefore if studying the motion in this case is meaningful on a statistical basis only, it makes no sense to analyse it by the Newtonian physics, but more efficient and less approximate methods are required such as the Statistical Physics and, being these sports sort of dynamic systems, the Chaos Theory.

Generally the Situational Sports could be classified as:
- Dual Sports
- Team Sports.

Each class has two sub-classes:

- No contact (with the opponent/s)
- With contact (with the opponent/s). This sub-class is also defined as "Pure".

Table 1) shows a general classification of Situational Sports according to this view.

	Situational Dual Sports		Situational Team Sports	
	No Contact	With Contact or Pure	No Contact	With Contact or Pure
Athletic Disciplines:	• Badminton • Squash • Table Tennis • Tennis	• Boxing • Fencing • Judo • Karate • Wrestling	• Baseball • Cricket • Softball • Tennis Doubles • Volleyball	• American Football • Bandy • Basketball • Football or Soccer • Handball • Hockey (Field,Ice, Skate) • Polo • Rugby • Water polo

Table 2 – A general classification of Situational Sports (Sacripanti, 2005)

Table 2) summarizes the general aims of biomechanical analysis applied to Situational Sports

	Situational Dual Sports		Situational Team Sports	
	No Contact	With Contact or Pure	No Contact	With Contact or Pure
General aims of the biomechanical analysis:	• Motion tracking • Specific conditions • Interactions (serve+motion+interaction)	• More complex motion tracking • Interactions motion+interaction)	• Motion tracking • Specific standard conditions • Interactions, both strategic and dynamic (serve+motion+passing+ interaction)	• Extremely complex motion tracking • Interactions, both strategic and dynamic (motion+passing+interaction)

Table 3 – The general aims of biomechanical analysis applied to Situational Sports

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Chapter 4

Conditioning, Training and Coaching (CTC) Processes and Controls

4.   Conditioning, Training and Coaching (CTC) Processes and Controls

4.1.   A general definition and historical perspective

The concept of Sport Training is an ever changing one, since it has been enriched by new definitions and meanings over several years and especially in the last three decades (Verchoshanskij, 2001abc; Weineck, 2001).

These definitions were all influenced by the different social, political and cultural contexts (Mintzberg, 1983) where they were designed, thus bringing different and original suggestions to the whole debate about the Sport Training Processes, and helping in establishing the basics of the Sport Sciences, as we know them at date.

4.2.   Sport Training definitions

Defining the Sport Training Process is not that easy as it could appear. Many authors gave definitions over the years (Harre, 1982; Manno,1989; Arcelli, 1990; Martin et al., 1997; Verchoshanskij, 1987; 2001abc; Weineck , 2001) and it seems opportune to give a global overview of what has been developed by some of them, underlining the different constructs that contributed to identify the specific features of the sport training methodologies.

Etymogically the Italian word "allenamento" (English related terms = conditioning-training-coaching)   comes from the Latin "ad lenam", (Gori and Marzi, 1988) improving the breathing capability, which is a generic feature of the sport performance. With this specific meaning, the English word, closer to the Italian "Allenamento", is the term "Conditioning", representing the process aimed to improve the physiological side of the performance.

Even the Italian word "addestramento" (English related terms = training-coaching) represents the synthesis of a broader concept related to the acquisition of specific skills (in sport, work or army settings). In its Italian forms, (addestramento-allenamento), these terms are very often used indifferently, not precisely according to many Italian authors.

The English term "coaching" represents, according to different authors, the highest level of the whole "training process", whereas it is used to describe the "art or science to lead an athlete or a group of athletes to perform in a efficient and skilled manner, in competitive situations or training stages" (Pieron, 1982).

In the Italian speaking sport world, even the term "coaching" is still an ambiguous term, used indifferently to describe the different processes of Conditioning and Training.

As above referred, it is clear that the general concepts of Conditioning-Training-Coaching, often represented by the single term "allenamento" in the Italian speaking sport world, has been influenced by several evolutions over the years, representing now a vast umbrella term (Dal Monte, 1977, 1983; Gori and Marzi; 1988; Manno, 1988, 1989; Arcelli,1990; Bosco, 1990, 1992, 1997; Bellotti e Donati, 1992; Madella et al.; 1994; Sacripanti, 2004; AAVV, 2005) synthesis of a broader concept, as we can note below in this chapter.

Nowadays the Italian term "allenamento" represents, among the insiders and/or the sport scientists, the synthesis of a wider concept describing the process of gaining and keeping the highest performance levels, suitable to cope with the demanded motor tasks, efficiently (the physiological side) and skilfully (the cognitive side).

The concept of "addestramento" ("practical training") seems to be more related to the acquiring process (Leali, 1983) of specific skills ("the technique"), although it is really difficult to clearly divide the technical results, obtained by training, from the physiological responses, particularly in the youth sport training process.

As reported above, other languages, such as English, have different terms to describe different processes, as "training", "coaching" or "conditioning". They are often translated by the Italian "allenamento", not granting punctual definitions of the concepts underlying these terms.

A key concept in modern training theory and methodology is that one of differentiating the process of a simple description of a skill and its first acquisition (the skill training), usually identified by: 1) presenting a specific skill through a demonstration or a model; 2) practicing the skill through specific exercises; 3) improving gradually the skill by increasing the coordinative and/or the conditional demands) from that one including situational or contextual demands (the "coaching", such as in small or facilitated games, (Wein, 1993) with high tactical meanings up to the complexity of the real game or match) emphasizing the importance of acquiring "experience" and "ability of reading the game or the situations", thus underlining the

cognitive involvements of the athlete/player, seen as a fundamental unity of body and mind (Weineck, 2001).

Under this point of view the key role of the coach is not only to provide "practises or drills", but help the athlete to immediately link his personal specific knowledge to the ongoing tactical situation (Leali, 1983; Wein, 1993, 1999).

The focus is set not only on "how to…" but rather on "when, where, why, who and what to…", leaving to the athlete/player the responsibility to decide the answer to give, basing on the information he got from the environment, his own past experiences and according to a general plan or frame (the strategy), agreed with the coach and other team mates, if the case.

The coaching process should ensure the development of the three components interacting while performing an open skill, the one required to compete in situation or context sports:

A perceptual level (reading the game or the situation, anticipating the events)

A decisional level (linked to the cognitive aspects and to the experience of the player)

An executive level (the performed skill as we can see and evaluate it, referring to the precision, power, speed, timing, efficiency, adaptability, etc.)

It is interesting to note in the following definitions the evolution of the concept of training, and how this concept was early characterized as a "process" [1], namely a "historical path" aimed to achieve specific goals.

In the concept of **"process"** the crucial topic of **"control"**, derived from **cybernetics**[2], is deeply embedded.

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[1] Generally speaking a process is defined as a **net of changing, activities or actions** linked to each others.

[2] The interdisciplinary science of cybernetics has remote origins. Robert Wiener (1894-1964) is considered the founding father and he summarized the key points as follows: *"Cybernetics is the science investigating the communication and the control processes in living creatures and in machines, seeking for principles and laws valid both for organisms and artificial systems".*

It is worth to be mentioned that the concept of "training" has been heavily influenced by the Marxist philosophy in the eastern countries (Harre,1982; Meinel, 1984), especially in the sixties and seventies, when the methodologies of training there adopted were based on the planning principles and the production control.

W. Hollmann (1963)

"Training is the sum of all the stimulus applied over a certain amount of time, that lead to morphological and functional changing of the body".

Wilhelm Hehlmann (1964)

"Training: functional planned drill, whether mental or physical, aimed to reach the best individual performance, especially in sport. The Rational Training and the Global Education methodologies may complete each other"

J. Stegemann (1971)

"Training is meant as an action aimed to improve the performance capacity through the measurable variation of the organic structure."

Dietrich Harre (1972)

"Training is the <u>process</u> of sport improvement aimed at scientific principles, particularly pedagogical, that by means of methodical and systematical influence over the performance capability, try to lead the athlete towards the maximal performance in an athletic discipline or sport activity."

W. Ulrich (1973)

" Sport Training is a planned <u>process</u> that causes an improvement of the skills and the abilities, that is even the plans and the structures of the motor action".

Klaus Carl , Kayser (1976)

"Sport Training is a complex action <u>process</u> that aims a planned and specific procedure of sport performance improvement."

Dietrich Martin (1977)

"Sport Training is a <u>process</u> supervised by a plan, that through the use of it ensures a variation of the performance level, according to specified objectives".

Carlo Vittori (1983)

"Sport Training is the setting of the physical exercise, repeated with a quantity and an intensity such as to produce progressively raising efforts that stimulate the physiological adaptation processes of the body so to promote the improving of the athlete's physical, psychological and technical abilities in order to consolidate and exalt the performance level during a competition".

Klaus Carl (1989)

"Sport training is a complex <u>process</u> of action that aims to influence the performance level and the ability to perform the selected skill in the best way as possible, in a planned manner and aiming to a specified subject".

Renato Manno (1989)

"Sport Training is a complex <u>process</u> of interventions whose aim is teaching and improving the sport technique, in a simple or articulated way, in individual, group or team situations and aiming to improve the psycho-physical qualities needed to achieve the maximal performances in individual, group or team athletic disciplines".

Enrico Arcelli (1990)

"Sport Training is the physical activity setting that provokes or maintains in the body those adaptations which may improve (or keep steady) the sport performances".

Yurij Verchoshanskij (2001)

"Sport Training is a multilateral pedagogical process, aimed to the global education of the athlete and, particularly, to:

- *the assimilation of a wide range of knowledge, abilities and skills;*
- *the improvement of the muscular work capacity of the body;*
- *the acquisition of the technique of the sport exercises;*
- *the mastery of the "art of competing".*

Carlo Vittori in Attilio Sacripanti (2005)

"Sport training is the (process of) repetition of concatenate exercises aimed to stimulate the relevant physiological properties or to improve some skills in order to improve the sport performance".

Attilio Sacripanti and Bruno Ruscello (2008)

Sport training is a complex process of development and specialization of the psycho-physical capabilities of the human being, particularly referred to a performed athletic discipline.

This process introduces a concatenate actions structure, aimed to activate various stimuli in order to optimise all the sport performance components. In this concatenate actions structure, a key role is played by the activation of various feed-back and control systems which supervise and orientate all the process, in relation to the set objectives.

4.3. Training Control

The control of the Process of Training and of the level of Sport Performance are important features in Training Methodology , that had received a major attention by the sport insiders and scientists.

Indeed the concept of "Training Control" has a peculiar influence on the various disciplines that combine to form the Sport Sciences:

1. the Sport Training Methodology
2. the Exercise Physiology
3. the Biomechanics
4. the Sport Psychology

The Functional Evaluation, the Performance Control and the Planning of the Training Process are all structural elements of the **Complex Training Control** (**CTC**), tightly connected to each other and hardly describable in a isolated manner.

"Synthetically Training Control indicates (ranging from short to long term) the process of tuning purposely all the measures of its:

-   planning
-   execution
-   controls
-   sport events or matches
-   assessment procedures

in order to raise the level of performance with the aim of achieving good results in sport activities"(Carl, Grosser, 1992).

This is to indicate that during the planning phase of the training process, people aim to identify some performance **Ideal Features** (which is a crucial aspect, especially considering the strategy and the tactic of play) to compare with the performance **Real Features,** once in evaluation stage.

Thus the crucial characteristics of the training process are its continuous **control** and **regulation.** That is the training must be planned and realized according to its own set objectives; the derived effects are then observed and diagnosed while the actual performed training sessions are filed and assessed, in order to ensure the relevant feedbacks on the whole process of training and its aims.

In Training Methodology this *regulatory circuit* is knows as the **Training Control Process** .
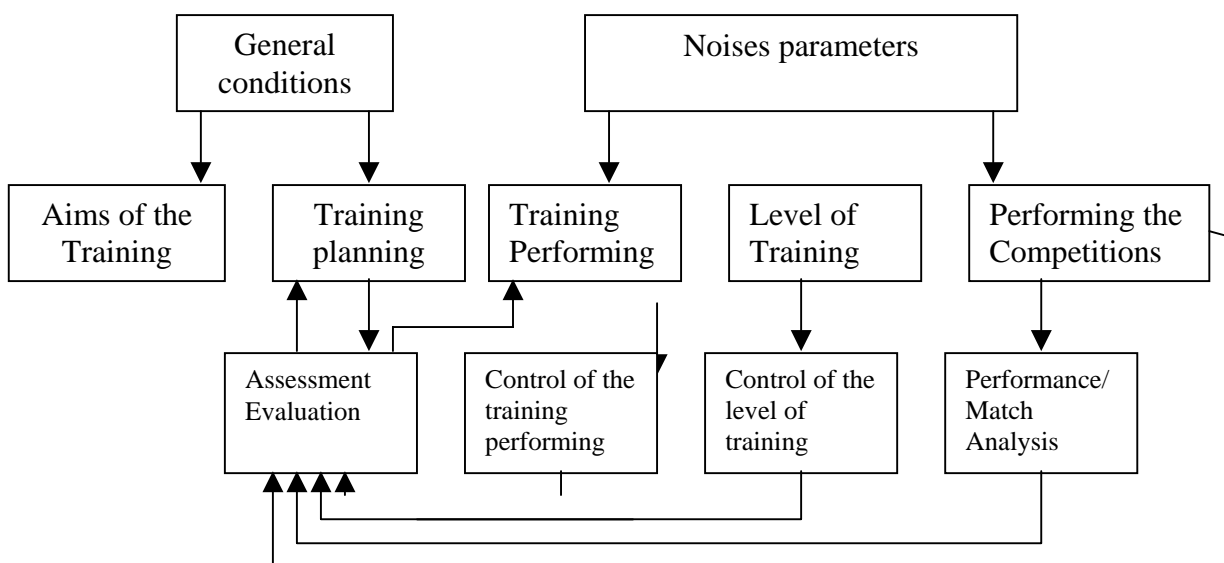
Figure 1 – The Training Control Process in the framework of the Training Process

4.4.   *Training Process Analysis: a sociological perspective.*

In order to analyse the Complex Process of Sport Training one might use a multidimensional and interdisciplinary approach, since the outcome of the processed information about the overall training process is hardly understandable if not

supported by an analysis that takes into account more than a tool suitable to understand the complex phenomenon of the training or competition (Pierangeli and Testa, 1994).

Max Weber[3] with the term "*process*" (Andrini, 1990), meant the performing and the occurrence of facts and phenomenon, having more or less deeper connections among them. The connection between this concept and the control dynamics of the existing interactions among the various parts of a process and their possible relationships is immediate. According to this author *"one ought to properly define a cognitive process that may provide an explanation that narrow down to a finite series of elements, determined from time to time according to a specific point of view, thus proceeding along a particular line of relationships of experiences, abstractedly isolated from other possible lines of research" (*in Mintzberg, 1983*).*

4.5. *Training Process Analysis: a pedagogical perspective.*

Generally speaking, the Pedagogical Process of Analysis and Evaluation is a strong point in every modern Sport Pedagogy (Hahn, 1986; Gori and Marzi,1988; Bellotti e Donati, 1992; Martin et al.; 1997; Weineck, 2001). A ticklish issue seems to be the problem referring to the analysis and the evaluation tools, their reliability, objectivity, specificity and repeatability.

The pedagogical relevance of using the iterative paradigm *"objective-action-analysis/evaluation-control-new objective",* typical in sport planning too, allows us to introduce another strong point into the Coach-Player relationship: that is the **measurement**, that often matches with the deeper needs of " judging correctness" felt by the athletes, especially in youngsters (Darst, 1989; Domenici; 1991; Donati et al., 1994).

Indeed measuring means analysing a phenomenon using the appropriate tools of the scientific approach (measuring the space, the time, the forces, etc.) in order to quantify the extent of the analysed event.

Analysing, evaluating and controlling are procedures of exceptional relevance, whereas they are set in a programmatic context, the general planning of the training

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[3] Max Weber (Erfurt, April 21st, 1864 - Munich, June 14th, 1920), was one of the most profoundly influential thinkers of the twentieth century. Born in Germany, Weber became a lawyer, politician, scholar, political economist, and sociologist. He was an indefatigable and eclectic writer who founded or co-founded a number of now separate academic disciplines, including the modern study of **sociology, public administration and organizational theory**.

process, that started and keeps going, grounding on the observed initial values (starting evaluation), during its progress (*in itinere* evaluation) until a possible final evaluation (Madella et al., 1994).

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Chapter 5

Analysing the CTC Processes: an interdisciplinary approach

5. Analysing the CTC Processes: an interdisciplinary approach

In order to analyse the Conditioning, Training and Coaching (CTC) Processes one might use an interdisciplinary approach, (Brettschneider, 1990; Weineck, 2001) that is the combination of several scientific disciplines integrating into a unified vision or field, that allows the experts to understand the complex structure of learning, performing, developing, optimising and adjusting the motor skills that are basilar in any sports or athletic disciplines.

In order to do so we will briefly introduce in this chapter some outlines regarding the different domains that currently may give possible answers:

- **The physiological domain**
- **The psychological domain**
- **The physical domain**

Match Analysis is about gathering knowledge on the skills performed by a player or a group of players (, and those skills may be better investigated if the different levels of performance are seen under the different points of view that the following domains can offer.

Of course aim of this thesis is not to provide an extensive dissertation about the different aspects of the various disciplines that combine in the three proposed domains but to give a global overview of what could be a future development of the training aspects in a new professional profile such as the Match Analysts.

5.1.   Introduction to the Physiological domain

Physiological domain is about life. The **Physiology** (from Greek φύσις, *physis*, "nature, origin"; and -λογία, *-logia*) is the study of the mechanical, physical, and biochemical functions of living organisms (Astrand and Rodahl, 2004). Physiology has traditionally been divided between **plant physiology** and **animal physiology** but the **principles of physiology are universal**, no matter what particular organism is being studied. For example, what is learned about the physiology of yeast cells may also apply to human cells.

The field of animal physiology extends the tools and methods of human physiology to non-human animal species. Plant physiology also borrows techniques from both fields. Its scope of subjects is at least as diverse as the tree of life itself. Due to this diversity of subjects, research in animal physiology tends to concentrate on understanding how physiological traits changed throughout the evolutionary history of animals. Other major branches of scientific study that have grown out of physiology research include **biochemistry, biophysics, paleobiology, biomechanics, pharmacology and exercise physiology**.

In sport environments **exercise physiology** (Astrand and Rodhal, 2004) is a major field of studies and researches.

5.1.1. Some historical perspective

The study of the physiology of exercise in a modern sense began in Paris, France, when Antoine Lavoisier in 1777 and Lavoisier and Pierre de Laplace in 1780 developed techniques to measure oxygen uptake and carbon dioxide production at rest and during exercise.

During the 1800s, European scientists used and advanced these procedures to study the metabolic responses to exercise (Scharling 1843; Smith 1857; Katzenstein 1891; Speck 1889; Allen and Pepys 1809).

The first major application of this research to humans, Edward Smith's study of the effects of "*assignment to hard labour*" by prisoners in London in 1857, was to determine if hard manual labour negatively affected the health and welfare of the prisoners and whether it should be considered cruel and unusual punishment.

William Byford published "*On the Physiology of Exercise*" in the American Journal of Medical Sciences in 1855, and Edward Mussey Hartwell, a leading physical educator, wrote a two-part article, *"On the Physiology of Exercise*" for the Boston Medical and Surgical Journal in 1887. The first important book on the subject, George Kolb's "*Beitrage zur Physiologie Maximaler Muskelarbeit Besonders des Modernen Sports"*, was published in 1887 (trans. Physiology of Sport, 1893) (cited in Langenfeld 1988 and Park 1992). The following year, Fernand Lagrange's *Physiology of Bodily Exercise* was published in France.

From the early 1900s to the early 1920s, several works on exercise physiology began to appear. George Fitz, who had established a physiology of exercise laboratory during the early 1890s, published his *Principles of Physiology*

and Hygiene in 1908. R. Tait McKenzie's *Exercise in Education and Medicine* (1909) was followed by such works as Francis Benedict and Edward Cathcart's *Muscular Work, A Metabolic Study with Special Reference to the Efficiency of the Human Body as a Machine* (1913). The next year, a professor of physiology at the University of London, F.A. Bainbridge, published a second edition of *Physiology of Muscular Exercise* (Park 1981). In 1923, the year Archibald Hill was appointed Professor of Physiology at University College, London, the physiology of exercise acquired one of its most respected researchers and staunchest supporters, for Hill had won the **Nobel Prize** in Medicine and Physiology the year before. Hill's 1925 presidential address on "*The Physiological Basis of Athletic Records*" to the British Association for the Advancement of Science appeared in The Lancet (1925) and Scientific Monthly (1925), and in 1926 he published his landmark book *Muscular Activity*.

The following year, Hill published *Living Machinery*, which was based largely on his lectures before audiences at the Lowell Institute in Boston and the Baker Laboratory of Chemistry in Ithaca, New York.

Several leading physiologists besides Hill were interested in the human body's response to exercise and environmental stressors, especially activities involving endurance, strength, altitude, heat, and cold. Consequently, they studied soldiers, athletes, aviators, and mountain climbers as the best models for acquiring data.

In the United States, such research was cantered in the Boston area, first at the Carnegie Nutrition Laboratory in the 1910s and later at the Harvard Fatigue Laboratory, which was established under the leadership of Lawrence Henderson in 1927 (Chapman and Mitchell 1965; Dill 1967; Horvath and Horvath 1973). That year, Henderson and colleagues first demonstrated that endurance exercise training improved the efficiency of the cardiovascular system by increasing stroke volume and decreasing heart rate at rest.

Two years later, Schneider and Ring (1929) published the results of a 12-week endurance training program on one person, demonstrating a 24-percent increase in "crest load of oxygen" (maximal oxygen uptake).

Over the next 15 years, a limited number of exercise training studies were published that evaluated the response of maximal oxygen uptake or endurance performance capacity to exercise training. These included noteworthy reports by Gemmill and colleagues (1931), Robinson and Harmon (1941), and Knehr, Dill, and

Neufeld (1942) on endurance training responses by male college students. However, none of those early studies compared the effects of different types, intensities, durations, or frequencies of exercise on performance capacity or health-related outcomes.

Activities surrounding World War II greatly influenced the research in exercise physiology, and several laboratories, including the Harvard Fatigue Laboratory, began directing their efforts toward topics of importance to the military.

The other national concern that created much interest among physiologists was the fear that American children were less fit than their European counterparts. Research was directed toward the concept of fitness in growth and development, ways to measure fitness, and the various components of fitness (Berryman 1995). Major advances were also made in the 1940s and 1950s in developing the components of physical fitness (Cureton 1947[1]) and in determining the effects of endurance and strength training on measures of performance and physiologic function, especially adaptations of the cardiovascular and metabolic systems.

Also investigated were the effects of exercise training on health-related outcomes, such as cholesterol metabolism (Brozek, Taylor, Anderson, Keys 1957; Montoye et al. 1960). Starting in the late 1950s and continuing through the 1970s, a rapidly increasing number of published studies evaluated or compared different components of endurance-oriented exercise training regimens. For example, Reindell, Roskamm (1959), and Gerschler (1962) in Germany, Christensen (1960) in Denmark, and Yakovlev and colleagues (1949-75) in Russia compared, and disagreed, about the relative benefits of interval versus continuous exercise training in increasing cardiac stroke volume and endurance capacity.

Other investigators began to evaluate the effects of different modes (Sloan and Keen 1959) and durations (Sinasalo and Juurtola 1957) of endurance-type training on physiologic and performance measures. Karvonen and colleagues' (1957) landmark paper that introduced using "*percent maximal heart rate reserve*" to calculate or express exercise training intensity was one of the first studies designed to compare the effects of two different exercise intensities on cardio respiratory responses during exercise.

Over the next 20 years, numerous investigators documented the effects of different exercise training regimens on a variety of health-related outcomes among

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[1] To have a quick overview of Cureton's works, see:
http://www.library.uiuc.edu/archives/uasfa/1603021.pdf

healthy men and women and among persons under medical care (Bouchard, Shephard, Stephens 1994).

Many of these studies evaluated the effects of endurance or aerobic exercise training on cardio respiratory capacity and were initially summarized by Pollock (1973).

The American College of Sports Medicine (ACSM) (1975, 1978) and the American Heart Association (AHA) (1975) further refined the results of this research.

Over the past two decades, experts from numerous disciplines have determined that exercise training substantially enhances physical performance and have begun to establish the characteristics of the exercise required to produce specific health benefits (Bouchard, Shephard, Stephens 1994).

Also, behavioural scientists have begun to evaluate what determines physical activity habits among different segments of the population and are developing strategies to increase physical activity among sedentary persons (Dishman 1988).

Aerobic training—Training that improves the efficiency of the aerobic energy-producing systems and that can improve cardiorespiratory endurance.*

Agility—A skill-related component of physical fitness that relates to the ability to rapidly change the position of the entire body in space with speed and accuracy.†

Anaerobic training—Training that improves the efficiency of the anaerobic energy-producing systems and that can increase muscular strength and tolerance for acid-base imbalances during high-intensity effort.*

Balance—A skill-related component of physical fitness that relates to the maintenance of equilibrium while stationary or moving.†

Body composition—A health-related component of physical fitness that relates to the relative amounts of muscle, fat, bone, and other vital parts of the body.†

Calorimetry—Methods used to calculate the rate and quantity of energy expenditure when the body is at rest and during exercise.*

   Direct calorimetry—A method that gauges the body's rate and quantity of energy production by direct measurement of the body's heat production; the method uses a calorimeter, which is a chamber that measures the heat expended by the body.*

   Indirect calorimetry—A method of estimating energy expenditure by measuring respiratory gases. Given that the amount of O_2 and CO_2 exchanged in the lungs normally equals that used and released by body tissues, caloric expenditure can be measured by CO_2 production and O_2 consumption.*

Cardiorespiratory endurance (cardiorespiratory fitness)—A health-related component of physical fitness that relates to the ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity.†

Coordination—A skill-related component of physical fitness that relates to the ability to use the senses, such as sight and hearing, together with body parts in performing motor tasks smoothly and accurately.†

Detraining—Changes the body undergoes in response to a reduction or cessation of regular physical training.*

Endurance training/endurance activities—Repetitive, aerobic use of large muscles (e.g., walking, bicycling, swimming).‡

Exercise (exercise training)—Planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness.

Flexibility—A health-related component of physical fitness that relates to the range of motion available at a joint.*

Kilocalorie (kcal)—A measurement of energy. 1 kilocalorie = 1 Calorie = 4,184 joules = 4.184 kilojoules.

Kilojoule (kjoule)—A measurement of energy. 4.184 kilojoules = 4,184 joules = 1 Calorie = 1 kilocalorie.

Maximal heart rate reserve—The difference between maximum heart rate and resting heart rate.*

Maximal oxygen uptake ($\dot{V}O_2$ max)—The maximal capacity for oxygen consumption by the body during maximal exertion. It is also known as aerobic power, maximal oxygen consumption, and cardiorespiratory endurance capacity.*

Maximal heart rate (HR max)—The highest heart rate value attainable during an all-out effort to the point of exhaustion.*

Metabolic equivalent (MET)—A unit used to estimate the metabolic cost (oxygen consumption) of physical activity. One MET equals the resting metabolic rate of approximately 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$.*

Muscle fiber—An individual muscle cell.*

Muscular endurance—The ability of the muscle to continue to perform without fatigue.*

Overtraining—The attempt to do more work than can be physically tolerated.*

Physical activity—Bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure.

Physical fitness—A set of attributes that people have or achieve that relates to the ability to perform physical activity.

Power—A skill-related component of physical fitness that relates to the rate at which one can perform work.

Relative perceived exertion (RPE)—A person's subjective assessment of how hard he or she is working. The Borg scale is a numerical scale for rating perceived exertion.*

Reaction time—A skill-related component of physical fitness that relates to the time elapsed between stimulation and the beginning of the reaction to it.†

Resistance training—Training designed to increase strength, power, and muscle endurance.*

Resting heart rate—The heart rate at rest, averaging 60 to 80 beats per minute.*

Retraining—Recovery of conditioning after a period of inactivity.*

Speed—A skill-related component of physical fitness that relates to the ability to perform a movement within a short period of time.†

Strength—The ability of the muscle to exert force.*

Training heart rate (THR)—A heart rate goal established by using the heart rate equivalent to a selected training level (percentage of $\dot{V}O_2$ max). For example, if a training level of 75 percent $\dot{V}O_2$ max is desired, the $\dot{V}O_2$ at 75 percent is determined and the heart rate corresponding to this $\dot{V}O_2$ is selected as the THR.*

*From Wilmore JH, Costill DL. *Physiology of sport and exercise*. Champaign, IL: Human Kinetics, 1994.
† From Corbin CB, Lindsey R. *Concepts in physical education with laboratories* 8th ed. Dubuque, IA: Times Mirror Higher Education Group, 1994.
‡ Adapted from Corbin CB, Lindsey R, 1994, and Wilmore JH, Costill DL, 1994.

Figure 1 – A short glossary of terms related to Exercise Physiology

5.1.2. Sport and Physiology

When challenged with any **physical task**, the human body responds through a series of **integrated changes** in function that involve most, if not all, of its physiologic systems (Carson and Cobelli, 2001; Astrand and Rodhal, 2004). Movement requires activation and control of the musculoskeletal system; the cardiovascular and respiratory systems provide the ability to sustain this movement over extended periods. When the body engages in exercise training several times a week or more frequently, each of these physiologic systems undergoes specific adaptations that increase the body's **efficiency** and **capacity**. The magnitude of these changes depends largely on the **intensity** and **duration** of the training sessions, the **force** or **load** used in training, and the body's **initial level of fitness**.

Removal of the training stimulus, however, will result in loss of the efficiency and capacity that was gained through these training-induced adaptations; this loss is a process called **detraining**.

Physiologic Responses to Episodes of Exercise

The body's physiologic responses to episodes of aerobic and resistance exercise occur in the musculoskeletal, cardiovascular, respiratory, endocrine, and immune systems. These responses have been studied in controlled laboratory settings, where exercise stress can be precisely regulated and physiologic responses carefully observed.

Cardiovascular and Respiratory Systems

The primary functions of the cardiovascular and respiratory systems are to provide the body with oxygen (O_2) and nutrients, to rid the body of carbon dioxide (CO_2) and metabolic waste products, to maintain body temperature and acid-base balance, and to transport hormones from the endocrine glands to their target organs (Wilmore and Costill, 1994).

To be effective and efficient, the cardiovascular system should be able to respond to increased skeletal muscle activity. Low rates of work, such as walking at 4 kilometres per hour, place relatively small demands on the cardiovascular and respiratory systems.

However, as the rate of muscular work increases, these two systems will eventually reach their maximum capacities and will no longer be able to meet the body's demands.

Cardiovascular Responses to Exercise

The cardiovascular system, composed of the heart, blood vessels, and blood, responds predictably to the increased demands of exercise. With few exceptions, the cardiovascular response to exercise is directly proportional to the skeletal muscle oxygen demands for any given rate of work, and oxygen uptake (VO_2) increases linearly with increasing rates of work.

Cardiac Output Cardiac output (Q) is the total volume of blood pumped by the left ventricle of the heart per minute. It is the product of heart rate (HR, number of beats per minute) and stroke volume (SV, volume of blood pumped per beat).

The arterial-mixed venous oxygen (A-vO_2) difference is the difference between the oxygen content of the arterial and mixed venous blood.

A person's maximum oxygen uptake (VO_2 max) is a function of cardiac output (Q) multiplied by the A-vO_2 difference. Cardiac output thus plays an important role in meeting the oxygen demands for work. As the rate of work increases, the cardiac output increases in a nearly linear manner to meet the increasing oxygen demand, but only up to the point where it reaches its maximal capacity (Qmax).

To visualize how cardiac output, heart rate, and stroke volume change with increasing rates of work, consider a person exercising on a cycle ergo meter, starting at 50 watts and increasing 50 watts every 2 minutes up to a maximal rate of work (Figure A, B, and C). In this scenario, cardiac output and heart rate increase over the entire range of work, whereas stroke volume only increases up to approximately 40 to 60 percent of the person's maximal oxygen uptake (VO_2 max), after which it reaches a plateau. Quite recent studies have suggested that stroke volume in highly trained persons can continue to increase up to near maximal rates of work (Ebashi and Ohtsuki, 2007).

(A)
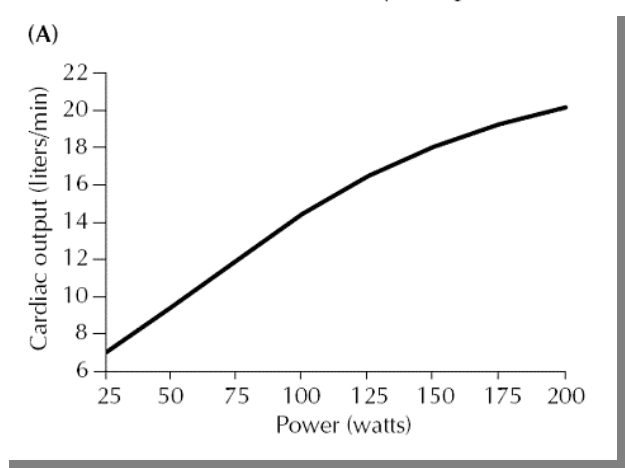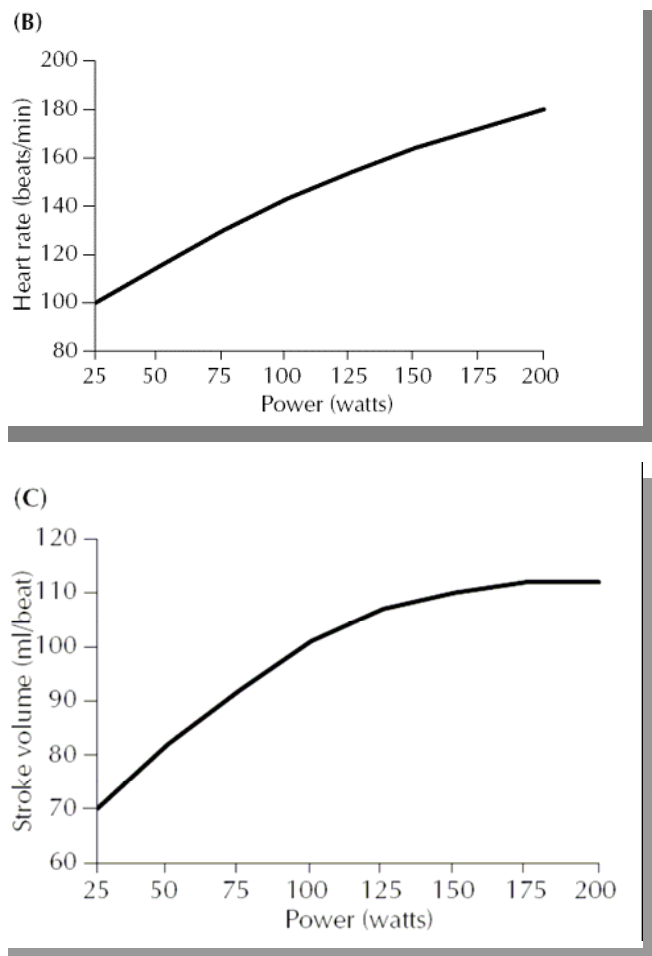
Figure A, B, C - Changes in cardiac output (A), heart rate (B), and stroke volume (C) with increasing rates of work on the cycle ergo meter

5.2. *Introduction to the Psychological domain*

Team sports are most concerned about tactics and strategies (Teodorescu, 1981; Sacripanti, 2007a,b). The implications of the "tactical-strategical thinking" are clearly evident to all the insiders (coaches, players, sport psychologists, etc.).

Sport psychology is the scientific study of people and their behaviors in sport. The role of a sport psychologist is to recognize how participation in sport exercise and physical activity enhances a person's development.

5.2.1. Attentive styles

The cognitive psychology of vision is an active area of research fraught with competing and complementary theories, numerous studies, and an array of interesting results.

Several areas of investigation in visual perception have relevance to our pursuit of links between perceptual quality of images and rendering decisions.

The characteristics of the physical and sports activities, mainly in situation sports, require the athlete's capacity to **simultaneously perform** an analysis of the visual information, in order to first understand the ongoing situation, (psycho-semantic information), and second to produce with accuracy the motor action, through the psycho-sensory-motor information (Ripoll,1989).

One of the stimuli which can most increase concentration and attention is the optical one. Certain colours capture the vision and relate it to the actions which are being carried out in the same instant as they are being observed, especially in the case of actions which are repeated over time, stimulating the vision-memory fixation axis. Specific training exercises for the purpose of training concentration in tennis were set up and described in a research carried out by Zanolli et Al. (1989).

These are based on making the intersections of the court lines stand out through the use of colour or on the use of coloured areas, which the athlete has to aim at and hit during the technical execution of certain strokes. As confirmation of the validity of the system the researchers described a statistical study carried out on a sample group of high level tennis players, confirming their hypothesis.

In attention we can identify four different components:

1. awareness,
2. selection,
3. spatial bearings,
4. mental concentration.

A study carried out by Castiello and Umiltà (1986) describes the application to young athletes of two tests created for gauging the spatial bearing capacity in the absence of eye movements (utilization of the so called "periferical sight") and the mental concentration required by two situations of differently complex visual-motor integration. Results showed how a period of physical activity could lead to an increase in the response speed thanks to an increased awareness. The capacity of directing one's attention is not altered after a period of physical activity, but older subjects appear better able to derive benefits from directing the attention without the drawbacks suffered by younger subjects. Physical activity does not seem to influence the capacity of mental concentration but older subjects show a greater capacity, ad compared to younger subjects, to integrate visual-motor responses of some complexity.

5.2.2. Exploratory strategies

The study of movement and motor learning originated from two separate fields of investigation: neurophysiology and psychology. Action theory acts as a bridge between the two sciences and suggests that their integration has produced a view of mental representations of movement as hierarchical systems in which action is the result of activity integrated by different sub-systems (Cei, Buonamano, 1991).

5.2.3. Decision making processes

The domain of sports offers an excellent opportunity for the study of decision making, for a number of reasons. Within the topical scope of sports decision-making, there are a number of different decision agents (coaches, players, etc.), tasks (play-calling, ball allocation, etc.), and contexts (during play, during timeout, etc.). This provides the chance to examine a variety of interesting designs. Yet, each combination of the above factors produces a unique interaction of important elements that affect the way decisions are made.

Although there is no "standard" type of decision in sports, there are some characteristics that seem general enough to abstract from this domain (Rubinstein, 1975).

The **key feature of sports decisions** is that they are naturalistic, meaning here that they are made by agents with some degree of task familiarity, in the environment with which they naturally encounter the decision (Orasanu & Connolly, 1993). The difference between the study of decision-making in the laboratory and the "real world" is an important distinction that has only recently been appreciated in decision research. Contrast three decision scenarios facing a forward in soccer: selecting the recipient of a pass in a real soccer match; selecting the recipient of a pass in a computer simulation of soccer; and selecting from among a set of gambles. Obviously, if we are interested in how this agent actually makes decisions, then those she normally faces should provide the most valid evidence. In situations where the experimenter attempts to recreate the natural environment, there is the danger of incorrectly specifying the underlying structure (e.g. programming computer players different from the way real players behave). If the experiment uses a different domain altogether, even if the underlying abstract structure is the same, performance often does not transfer to the new domain (e.g., Ceci & Ruiz, 1993; Raab, 2005).

Second, the majority of sports decisions are dynamic. Decisions in sports, as well as in many other domains, unfold over time. The influence of this dynamic aspect is (at least) twofold. There are internal dynamics, meaning there is not so much a single point of decision as there is a course of deliberation. Information is not instantaneously gathered and processed; rather a decision maker must accrue information over time, and subsequent processing of this information takes additional time. Furthermore, sports situations possess external dynamics, meaning

that the situation itself changes over time. At one moment, some information may be available (e.g., goalie position) that is not available in the next moment (e.g., due to obstruction). Other variables, such as available options (e.g., teammates without proximate defenders), may change over time as well. Third, decisions in sports are often made "online," or under similar conditions of moderate or high time pressure. This feature is related to, but distinct from, the dynamic nature of sports decisions. While sports are indeed dynamic tasks, the decisions about what to do in these situations can be made either online (during the task), or in a reflective manner. Most decisions made by athletes are made online, while the play is in motion. Alternatively, as an example of a reflective decision, imagine a coach deciding which player to start in an upcoming game, based on all the available information about his technical staff and the opposing team's players.

Finally, an element of variability must be realized when studying sports decisions. It is important, in sports situations, to avoid a deterministic mapping from situation to response.

Although the use of "if–then" rules may be a common method for instruction (e.g., McPherson & Kernodle, 2003), one can imagine the peril in performing the same action every time one is found in a given situation. Unpredictability in sports denies an opponent the opportunity to know what offensive play will be called, what defensive formation they will face, or to whom the ball will go in the final seconds of a close contest.

The factors above are by no means complete, and cannot be assumed to describe every sports situation.

Johnson (2006) carried out an interesting research with the purpose of providing an introduction to the benefits of cognitive models applied to sports decision-making. The use of cognitive models in sports offers advantages for other aspects of behavior as well, such as perception and memory. Sequential sampling models in particular have been applied to these domains, and it would be interesting to see if sequential sampling principles could explain a wealth of cognitive activity in sports, such as memory organization or knowledge representation of sports experts (e.g., Chase & Simon, 1973; Zoudji and Thon, 2003).

The use of sequential sampling models was motivated by their correspondence with the dynamic, stochastic processes that characterize decision making in sports.

Sport provides a fascinating arena for modelling strategic decisions. There is a wealth of available or potentially available data; action sets are often well defined; and match states are often repeated. Furthermore, the notion of fairness is artificially imposed upon sporting contests through the rules or laws of the sport. This "fairness" maintains ***competitive balance*** which is so important to the long term survival of a sport/interest in "one-sided" competitions, both from the point of view of players and spectators, soon wanes. However, the notion of competitive balance or fairness means that coaches will continually seek means to obtain a competitive edge. Administrators of a sport will tend to act to redress imbalance through changes to rules and contest design. The quantitative modelling of strategy offers a means of obtaining a competitive edge.

An interesting overview of the above reported has been recently offered by Scarf and McHale (2007), who carried out a research on ***track sprint in cycling***. They noted that it is relatively straightforward to observe the race state and actions taken throughout the event. Obtaining a competitive edge in this Olympic sport has the potential to translate into additional medals for UK Sport and British Cycling in particular. The project will build a prototype **decision model** for the track sprint and the model will be used to explore **optimum strategy** for this event. In particular, the model will be used to investigate "off-line", in a non-exhausting training environment, the effect of strategic alternatives on the outcome of the event. The model will allow exploration of strategy that differs from the received wisdom. The prototype model will be used to assess the potential for an extended model and training simulator to impact upon the competitiveness of UK track cycling and other related events in the 2012 Olympics.

In the words of the report of the EPSRC/UK Sport meeting on "Achieving Gold", where the idea for this project was first conceived, the project will take a number of steps towards "**characterising winning moves**" in sport in general, in order to "to train an athlete to act optimally" and thus "separate intuition from technique".

Sport and management activities show many links and the path leading to success seems to be quite similar (Duncan, Oates, 1994). In sport as in work, defining the objectives, self-committing to achieve the best performance, team work, interactive communication and, of course, success seeking are fundamental aspects.

Work and sport psychology share the same interest for evaluation, referring to the possibility of prediction, in the first case about the actual and potential working trends (De Carlo, 2002), in the second about the competitive behaviour.

In both the cases from those evaluations the relevant strategies of improving performances originated.

With a specific respect to sport psychology, the measurement of the performance psychological components represents a major issue, since the early 1960s, with the "illusion" of defining the "athlete's ideal profile".

The prediction of competitive behaviours has first been entrusted to the personality traits study, through non-specific tools of research. No scientific evidence has been found proving a relationship between personal traits and sport achievements (Singer, Hausenblas, Janelle, 2001). From 1980s on, people witnessed a shift to Cognitive Psychology; again in those years the use of psychophysiological measures began (Hatfield, Landers, 1983).

The major critics to these lines of research are related to the fact that no theory explaining how and how much those evaluated factors has been effectively provided (Van den Auweele, Nys, Rzewnicki, Van Mele, 2001).

The contextual sport setting and the specific sport requirements Analysis

The aim is to contextualize the psychological assessment within the specific cultural background the athlete belongs to. Therefore the knowledge of a system of beliefs, of implicit and explicit rules, of behavioural models, of myths and rituals, that characterize the culture of the athlete (Avallone, 1996).

The reference structural framework should be:

1) The precise knowledge of the agonistic level of the athlete or of the team;

2) The sport specific features (open or closed skills based; team sport, endurance, power, etc. and the relevant training characteristics);

3) The athlete's responsibility and involvement degree in choosing the training programme;

4) The competition's characteristics (duration, number of trials, environment, judges or referees, objective or subjective criteria of result evaluation, etc.);

5) The current career stage of the athlete: Junior; Senior, Beginners, Experts, etc.

We owe to Work Psychology the attention to the management culture analysis, that projects in a broader dimension the evaluation of the individuals. The tools used in this stage are not dissimilar to those used in Job Analysis: observation during matches and training sessions, conversations and interviews to the athletes, coaches and officials and prominent retired athletes, study of the specific scientific literature.

Athlete's Self-awareness

The Top Athlete, considering his/her performances and experiences, has to be considered the *top expert* of his/her own athletic discipline.

Therefore we can consider the athlete having a good self-awareness of which psychological components are the crucial ones in achieving a result and able to provide even a measure of that.

In this sense the evaluation aims at providing the athlete the feedbacks regarding his/her own abilities, beliefs, feelings and behaviours and, in the same time, driving him/her to commit himself in a continuous self-assessment and monitoring (Vealey and Garner-Holman, 1998). This stage is crucial in order to participate actively in the definition of specific training programme.

The available tools in this phase are numerous. Recurrent is the use of questionnaires (i.e. Performance Feedback Sheet by Ravizza –1993; the Mental Skill Assessment by Botteril – 1990 and the Ottawa Mental Skill Assessment Tool by Salmela, 1995).

Recently in Italian Sport, two major techniques have proven to be effective in Olympic athletes assessment.

The first one is the Performance Profiling (Butler, Hardy, 1992), theoretically grounded into the *Personal Constructs Theory* by George Kelly (1955), which underlines the relevance of the uniqueness of the construct systems that differentiate the individuals in their way of perceiving, intepretating and anticipating the events. In this sense, the athlete may be considered as a person committed to build a complex theory regarding his own conditions, under the physical, technical, tactical and psychological point of view.

The Performance Profiling technique allows to investigate and to point out the athlete's own perspective, and to share it with the coach, enlarging the athlete self-awareness.

Ability in Anxiety Management
Confidence
Tenacity, Persistency
Sport Intelligence
Focus Ability
Ability in avoiding distractions
Ethic of Sacrifice
Ability in pursuing objectives
Coachability
Optimism
Adaptive perfectionism

Table 1 – Psychological Features considered relevant by Gold Medallist OlympicCoaches

5.3 Introduction to the Physical domain

To start with, I would like to make a little experiment.
Just raise a hand who thinks to see me.
I can see many hands up.
I gather that madness loves company.
You don't see me:
what you see is a heap of information about me,
that you synthesise in a visual image of me.
You built that image!
(Gregory Bateson, 1983)

The **physical domain** is the conventional domain we are familiar with which contains length, width, height, and time. The physical domain is where all matter and also all physical energy, such as chemical or electromagnetic energy interacts.

The most powerful tool we can use to explore and investigate this domain is Mathematics.

Mathematics let us to understand the universe through the process of modelling[2].

This definition suggests that modelling is an activity, a cognitive activity in which we think about and make models to describe how devices or objects of interest behave. There are many ways in which devices and behaviours can be described. We can use words, drawings or sketches, physical models, computer programs, or mathematical formulas. In other words, the modelling activity can be done in several languages, often simultaneously. Since we are particularly interested in using the language of mathematics to make models, we will refine the definition just given:

mathematical model*: a representation in mathematical terms of the behaviour of real devices and objects.*

We want to know how to make or generate mathematical representations or models, how to validate them, how to use them, and how and when their use is limited.

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[2] **model***: a miniature representation of something; a pattern of something to be made; an example for imitation or emulation; a description or analogy used to help visualize something (e.g., an atom) that cannot be directly observed; a system of postulates, data and inferences presented as a mathematical description of an entity or state of affairs.*

5.3.1. Mathematical Modelling and the Scientific Method

In an elementary picture of the scientific method (see Figure 1), we identify a "real world" and a "conceptual world." The external world is the one we call real; here we observe various phenomena and behaviours, whether natural in origin or produced by artefacts. The conceptual world is the world of the mind—where we live when we try to understand what is going on in that real, external world. The conceptual world can be viewed as having three stages: observation, modelling, and prediction. In the observation part of the scientific method we measure what is happening in the real world.

Here we gather empirical evidence and "facts on the ground." Observations may be direct, as when we use our senses, or indirect, in which case some measurements are taken to indicate through some other reading that an event has taken place. For example, we often know

a chemical reaction has taken place only by measuring the product of that reaction. In this elementary view of how science is done, the modelling part is concerned with analysing the above observations for one of (at least) three reasons. These rationales are about developing:
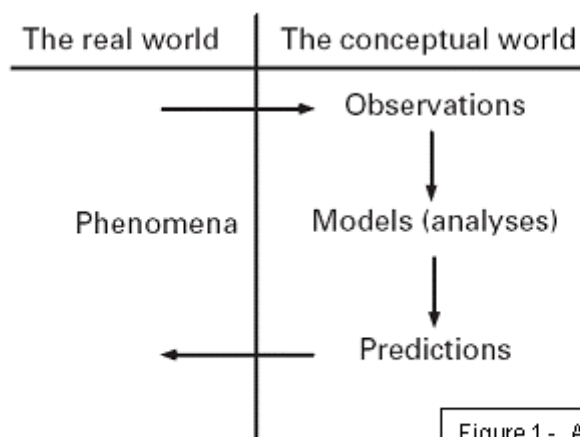
Figure 1 - An elementary depiction of the *scientific method* that shows how our conceptual models of the world are related to observations made within that real world.
(Dym and Ivey, 1980).

1. *models that describe the behaviour or results observed*;
2. *models that explain why that behaviour and results occurred as they did;*
3. *or models that allow us to predict future behaviors or results that are as yet unseen or unmeasured*.

In the prediction part of the scientific method we exercise our models to tell us what will happen in a yet-to-be-conducted experiment or in an anticipated set of events in the real world. These predictions are then followed by observations that serve either to validate the model or to suggest reasons that the model is inadequate. The last point clearly points to the looping, iterative structure apparent in Figure 1.

It also suggests that modelling is central to all of the conceptual phases in the elementary model of the scientific method. We build models and use them to predict events that can confirm or deny the models. In addition, we can also improve our gathering of empirical data when we use a model to obtain guidance about where to look.

5.3.1.1. Principles of Mathematical Modelling

Mathematical modeling is a principled activity that has both principles behind it and methods that can be successfully applied (Cha et al., 2000). The principles are over-arching or meta-principles phrased as questions about the intentions and purposes of mathematical modelling. These meta-principles are almost philosophical in nature (Kemeny, 1959).

A visual portrayal of the basic philosophical approach is shown in Figure 2).
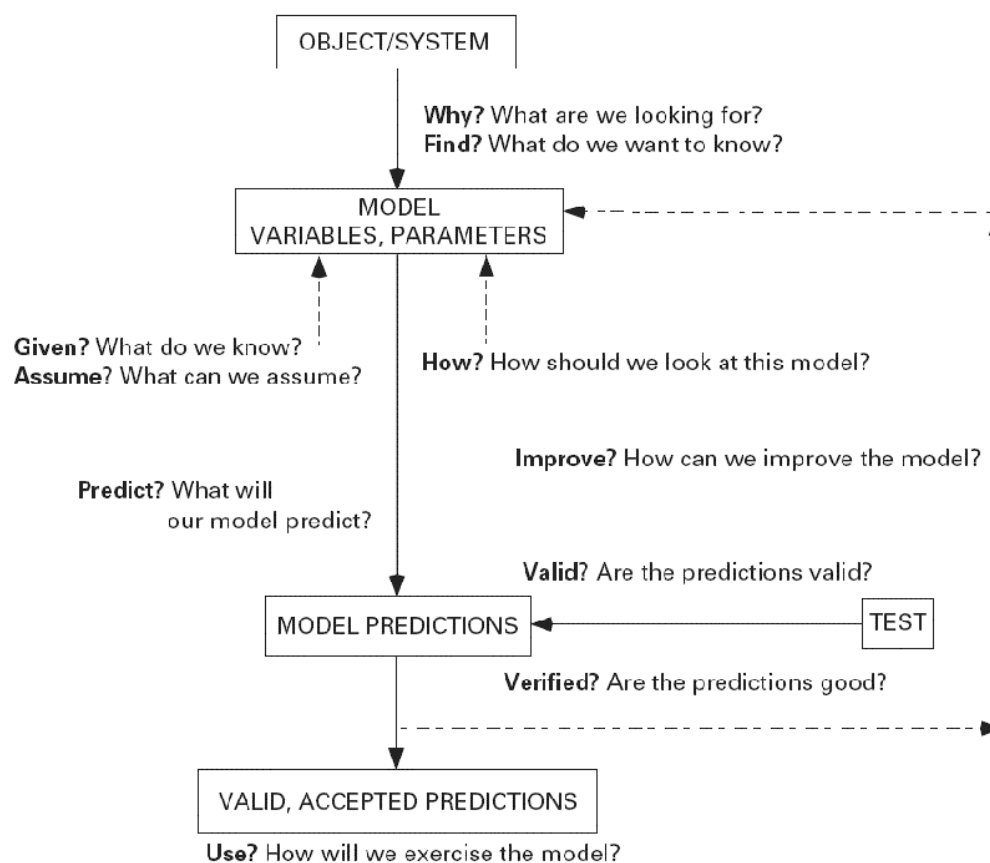
Figure 2 - A first-order view of *mathematical modelling* that shows how the questions asked in a principled approach to building a model relate to the development of that model (inspired by Carson and Cobelli, 2001).

These methodological modelling principles are also captured in the following list of questions and answers:

- **Why?** What are we looking for? Identify the need for the model.

- **Find?** What do we want to know? List the data we are seeking.

- **Given?** What do we know? Identify the available relevant data.

- **Assume?** What can we assume? Identify the circumstances that apply.

- **How?** How should we look at this model? Identify the governing physical principles.

- **Predict?** What will our model predict? Identify the equations that will be used, the calculations that will be made, and the answers that will result.

- **Valid?** Are the predictions valid? Identify tests that can be made to validate the model, i.e., is it consistent with its principles and assumptions?

- **Verified?** Are the predictions good? Identify tests that can be made to verify the model, i.e., is it useful in terms of the initial reason it was done?
- **Improve?** Can we improve the model? Identify parameter values that are not adequately known, variables that should have been included, and/or assumptions/restrictions that could be lifted. Implement the iterative loop that we can call "model-validate-verify-improve-predict."
- **Use?** How will we exercise the model? What will we do with the model?

This list of questions and instructions is not an algorithm for building a good mathematical model. However, the underlying ideas are key to mathematical modelling, as they are key to problem formulation generally. Thus, we should expect the individual questions to recur often during the modelling process, and we should regard this list as a fairly general approach to ways of thinking about mathematical modelling (Dym, 1980). Having a clear picture of why the model is wanted or needed is of prime importance to the model-building enterprise.

5.3.1.2. Some Methods of Mathematical Modelling

Now we will review some of the mathematical techniques we can use to help answer the philosophical questions posed above. These mathematical principles include:
- *dimensional homogeneity,*
- *abstraction and scaling,*
- *conservation and balance principles,*
- *consequences of linearity.*

Dimensional Homogeneity and Consistency

There is a basic, yet very powerful idea that is central to mathematical modelling, namely, that every equation we use must be *dimensionally homogeneous* or *dimensionally consistent*. It is quite logical that every term in an energy equation has total dimensions of energy, and that every term in a balance of mass should have the dimensions of mass. This statement provides the basis for a technique called *dimensional analysis*.

It is also worth to be mentioned the important distinction between physical **dimensions** that relate a (derived) quantity to fundamental physical quantities and **units** that are numerical expressions of a quantity's dimensions expressed in terms of a given physical standard.

Abstraction and Scaling

An important decision in modelling is choosing an appropriate level of detail for the problem at hand, and thus knowing what level of detail is prescribed for the attendant model. This process is called **abstraction** and it typically requires a thoughtful approach to identifying those phenomena on which we want to focus, that is, to answering the fundamental question about why a model is being sought or developed.

For example, a linear elastic spring can be used to model more than just the relation between force and relative extension of a simple coiled spring, as in an old-fashioned butcher's scale or an automobile spring. It can also be used to model the static and dynamic behaviour of a tall building, perhaps to model wind loading, perhaps as part of analysing how the building would respond to an earthquake. In these examples, we can use a very abstract model by subsuming various details within the parameters of that model.

In addition, as we talk about finding the right level of abstraction or the right level of detail, we are simultaneously talking about finding the **right scale** for the model we are developing. For example, the spring can be used at a much smaller, micro scale to model atomic bonds, in contrast with the macro level for buildings. The notion of **scaling** includes several ideas, including the effects of **geometry on scale**, the **relationship of function to scale**, and the **role of size in determining limits,** all of which are needed to choose the right scale for a model in relation to the "reality" we want to capture.

Conservation and Balance Principles

When we develop mathematical models, we often start with statements that indicate that some property of an object or system is being conserved. For example, we could analyse the motion of a body moving on an ideal, frictionless path by noting that its energy is conserved. Sometimes, as when we model the population of an animal colony or the volume of a river flow, we must balance quantities, of individual animals or water volumes, that cross a defined boundary. We will apply **balance or conservation principles** to assess the effect of maintaining or conserving levels of important physical properties. Conservation and balance equations are related; in fact, conservation laws are special cases of balance laws. The mathematics of balance and conservation laws are straightforward at this level of abstraction. Denoting the physical property being monitored as *Q(t)* and the independent

variable time as **t** , we can write a balance law for the temporal or time rate of change of that property within the system boundary depicted in Figure 3 as:

$$\frac{dQ(t)}{dt} = q_{in}(t) + g(t) - q_{out}(t) - c(t)$$

(5.1)

where $q_{in}(t)$ and $q_{out}(t)$ represent the flow rates of $Q(t)$ into (the influx) and out of (the efflux) the system boundary, g (t) is the rate at which Q is generated within the boundary, and c(t) is the rate at which Q is consumed within that boundary. Note that eq. (1.1) is also called a **rate equation** because each term has both the meaning and dimensions of the rate of change with time of the quantity Q(t).
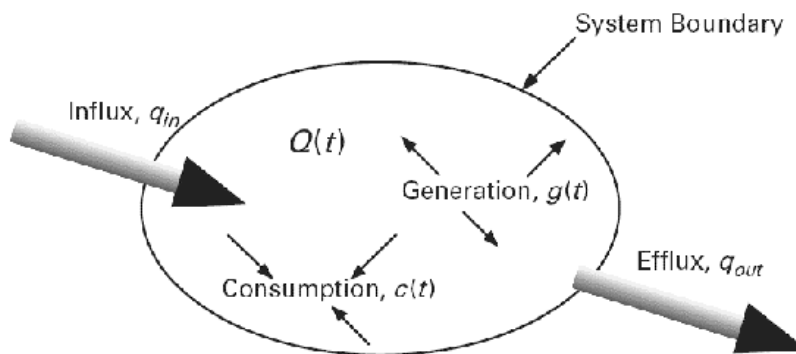
Figure 2 - A system boundary surrounding the object or system being modelled. The influx q_{in} (t), efflux q_{out} (t), generation g(t), and consumption c(t), affect the rate at which the property of interest, Q(t), accumulates within the boundary (after Cha, Rosenberg, and Dym, 2000).

In those cases where there is no generation and no consumption within the system boundary (i.e., when $g = c = 0$), the balance law in eq. (5.1) becomes a conservation law: $dQ(t) \, dt = q_{in}(t) - q_{out}(t)$. (5.2)

Here, then, the rate at which $Q(t)$ accumulates within the boundary is equal to the difference between the influx, $q_{in}(t)$, and the efflux, $q_{out}(t)$.

Constructing Linear Models

Linearity is one of the most important concepts in mathematical modelling. Models of devices or systems are said to be linear when their basic equations—whether algebraic, differential, or integral—are such that the magnitude of their behaviour or response produced is directly proportional to the excitation or input that drives them. Even when devices like a pendulum are more fully described by non-linear models, their behaviour can often be approximated by linearised or perturbed models, in which cases the mathematics of linear systems can be successfully applied. We apply linearity when we model the behaviour of a device or system that is forced or pushed by a complex set of inputs or excitations. We obtain the response of that device or system to the sum of the individual inputs by adding or superposing the separate responses of the system to each individual input. This important result is called the **principle of superposition**. Engineers use this principle **to predict** the response of a system to a complicated input by **decomposing** or **breaking down** that input into a set of simpler inputs that produce known system responses or behaviours.

5.3.2. Introduction to Cybernetics

According to the definition given by Norbert Wiener, *"Cybernetics is the science investigating the communication and the control processes in living beings (or animals) and machines"*.

Its main aim is to postulate valid laws and principles both for living creatures and artificial systems.

The term Cybernetics originated from the ancient Greek "Kubernetes", the helmsman or the pilot of a ship. The idea of helmsman, as a sovereign or governor, was already used as a political metaphor in the ancient Greek world (La Rosa et al., 2006).

 A.M. Ampere in 1843 indicated Cybernetics as «the art of governing»[3], but this specific meaning had no impact subsequently.

Current use of this term is still linked to the concept of "ruling" but in the sense of "regulation".

The emblematic cybernetic device, and maybe the oldest, is the well known James Watt's centrifuge regulator, but the true birth of this science is the publishing of the Wiener's book *Cybernetics, or control and communication in the animal and in the machine* in 1948*.*

5.3.2.1. Cybernetics Cultural Framework

The extreme concision of Wiener's definition requires some clarification. We can find in it two **combinations**: the first one is between **control** and **communication** and it is not problematic. The second one, between **animal** and **machine** (that will be considered later on as the combination between "natural" and "artificial") is much more surprising for the general acceptance accorded to the scientific methods applied. The consequences are enormous.

One can say that Cybernetics deep core is about a scientific programme aimed to prove the validity of the following: *in the communication and control domains, the* ***natural solutions*** *created during the process of evolution (main subject of the*

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[3] A.M. Ampere; 1843; « Essai sur la philosophie des sciences ou exposition analytique d'une classification de toutes les connaissances humaines »

*scientific investigations) and **those ones** carried out by the scientific advances in technology (subject of the engineering designing) are coinciding in a deep sense."*

As the wheel differs from the natural means of locomotion and the thermal and electric machines differ from muscles and lashes, even if the same laws apply both for living and artificial beings, in the same way in the new fields of communication and control ones hoped for the discovery of laws and principles that grounded both for natural and artificial world.

However those laws and principles did not appear with the same authority as in other classical scientific disciplines: mathematics, physics, biology and so on.

5.3.2.2. Cybernetics Specific Issues

Cybernetics may be described as a structure formed by three general major components:

1. Feed-back
2. Adaptive systems and self-organization
3. Neural Networks.

Feed-back

Feed-backed systems are those ones in which parts of the outgoing signal (the so-called error-signal in output) are taking back to the input area, altering the input-output relationship that characterises the system, in a way that one may consider as external to the system in itself. Through this process one may exert a control on the system itself.

This taking back part of the output to the input zone may happen in different ways and depending on the magnitude and on the mathematical operations involved, ones may have very different types of feed-backs.

The most common kind of feed-back is the so-called **negative feed-back***, where the error signal is taken away from the input signal. In this case the aim of this system is to keep stable some specific parameter, such as the values of the amplitude and the phase of some outputting signal. Concepts as stable or oscillatory balance, identification, observability, controllability ed optimisation emerged from here.

Adaptive systems and self-organization

The feedback capacity of controlling a system behaviour with a given and partially unknown structure (the so-called "black-box") led to further considerations about the possibility of designing systems able to adapt to possibly changing environmental conditions, in order to maintain the task to achieve a set objective. Systems able to self-organise and even to reproduce autonomously (autopoietic processes) have been studied.

The problems, still not really solved, of those investigations are related to the exact meaning of "**purpose**" and "**finalised behaviour**", while referred to "autonomy behaviours". Another important issue is the huge **complexity** related to autonomy systems.

Neural Networks

Although the nervous system, the neurons and their models are mentioned by Wiener, the issue "neural networks" or "neuronal" is independent from that and precedes the Wiener vision.

In 1943 the neuroanatomist W.S. McCullogh and the mathematician W. Pitts in their article *"A logical calculus of the ideas immanent in the nervous activity"* proposed models of neurons, that can be considered as the origin of this branch of Cybernetics.

The connections among neurons in the network happened through links whose "weights" varied with the intensity of the use they are subjected to, thus modelling the nervous system plasticity.

F. Rosenblatt[4] used this possibility of variation of the network structure when designed his *Perceptron,* a neural network that learnt to correctly discriminate shapes belonging to different classes.

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[4] **Frank Rosenblatt** (11 July 1928– 1971) was a New York City born computer scientist who completed the Perceptron, or MARK 1, computer at Cornell University in 1960. This was the first computer that could learn new skills by trial and error, using a type of neural network that simulates human thought processes.
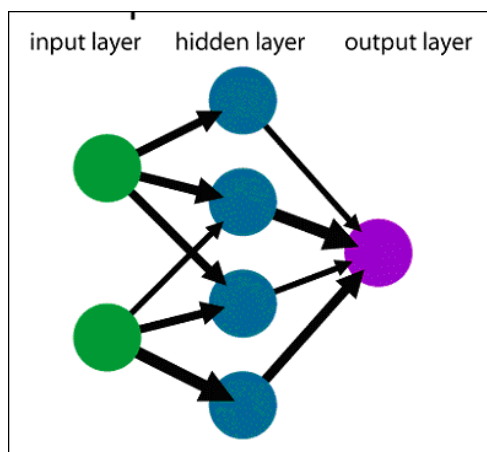
Figure 3 - Simplified view of an artificial neural network

Traditionally, the term neural network had been used to refer to a network or circuit of **biological neurons**. The modern use of the term often refers to **artificial neural networks**, which are composed of **artificial neurons** or **nodes**. Thus the term has two distinct meanings:

1. **Biological neural networks** are made up of real biological neurons that are connected or functionally related in the peripheral nervous system or the central nervous system. In the field of neuroscience, they are often identified as groups of neurons that perform a specific physiological function in laboratory analysis.

2. **Artificial neural networks** are made up of interconnecting artificial neurons (programming constructs that mimic the properties of biological neurons). Artificial neural networks may either be used to gain an understanding of biological neural networks, or for solving artificial intelligence problems without necessarily creating a model of a real biological system. The real, biological nervous system is highly complex and includes some features that may seem superfluous based on an understanding of artificial networks.

In general a **biological neural network** is composed of a group or groups of chemically connected or functionally associated neurons. A single neuron may be connected to many other neurons and the total number of neurons and connections in a network may be extensive. Connections, called **synapses**, are usually formed from **axons** to **dendrites**, though **dendrodendritic microcircuits** and other connections are possible. Apart from the electrical signaling, there are other forms of

signaling that arise from neurotransmitter diffusion, which have an effect on electrical signaling. As such, **neural networks** are extremely complex.

Artificial intelligence and **cognitive modeling** try to simulate some properties of neural networks. While similar in their techniques, the former has the aim of solving particular tasks, while the latter aims to build mathematical models of biological neural systems.

In the **artificial intelligence field**, artificial neural networks have been applied successfully to **speech recognition**, **image analysis** and **adaptive control**, in order to construct software agents (in computer and video games) or autonomous robots. Most of the currently employed artificial neural networks for artificial intelligence are based on **statistical estimation, optimization and control theory**.

The **cognitive modelling field** involves the physical or mathematical modelling of the behaviour of neural systems; ranging from the individual neural level (e.g. modelling the spike response curves of neurons to a stimulus), through the neural cluster level (e.g. modelling the release and effects of dopamine in the basal ganglia) to the complete organism (e.g. behavioural modelling of the organism's response to stimuli).

Neural networks and Artificial Intelligence

An *artificial neural network* (ANN), also called *a simulated neural network* (SNN) or commonly just *neural network* (NN) is an interconnected group of artificial neurons that uses a mathematical or computational model for information processing based on a **connectionistic approach** to computation (Simon, 1999). In most cases an ANN is an **adaptive system** that changes its structure based on external or internal information that flows through the network.
In more practical terms neural networks are non-linear statistical data modeling or decision making tools. They can be used to model complex relationships between inputs and outputs or to find patterns in data (such as in Data Mining).

An artificial neural network involves a network of simple processing elements (artificial neurons) which can exhibit complex global behaviour, determined by the connections between the processing elements and element parameters. Artificial

neurons were first proposed in 1943 by Warren McCulloch, a neurophysiologist, and Walter Pitts, an MIT logician, as reported previously. One classical type of artificial neural network is the **Hopfield net**.

In a neural network model simple **nodes**, which can be called variously "**neurons**", "**neurodes**", "**Processing Elements**" (**PE**) or "**units**", are connected together to form a **network of nodes**, hence the term "**neural network**". While a neural network does not have to be adaptive per se, its practical use comes with algorithms designed to alter the strength (weights) of the connections in the network to produce a desired signal flow.

In modern software implementations of artificial neural networks the approach inspired by **biology** has more or less been abandoned for a more practical approach based on **statistics** and **signal processing**. In some of these systems neural networks, or parts of neural networks (such as artificial neurons) are used as components in larger systems that combine both **adaptive** and **non-adaptive elements**.

The concept of a neural network appears to have first been proposed by Alan Turing in his 1948 paper "Intelligent Machinery".

Applications of artificial neural networks

The utility of artificial neural network models lies in the fact that they can be used to infer a function from observations and also to use it. This is particularly useful in applications where the complexity of the data or task makes the design of such a function by hand impractical.

Real life applications:

The tasks to which artificial neural networks are applied tend to fall within the following broad categories:

- Function approximation, or regression analysis, including time series prediction and modelling.
- Classification, including pattern and sequence recognition, novelty detection and sequential decision making.
- Data processing, including filtering, clustering, blind signal separation and compression.

- Application areas include system identification and control (vehicle control, process control), game-playing and decision making (backgammon, chess, racing), pattern recognition (radar systems, face identification, object recognition, etc.), sequence recognition (gesture, speech, handwritten text recognition), medical diagnosis, financial applications, data mining (or knowledge discovery in databases, "KDD"), visualization and e-mail spam filtering.

5.3.3. Introduction to Information Theory

*The fundamental problem of communication is that of reproducing at
one point either exactly or approximately a message selected at another point.*
(Claude Shannon, 1948)
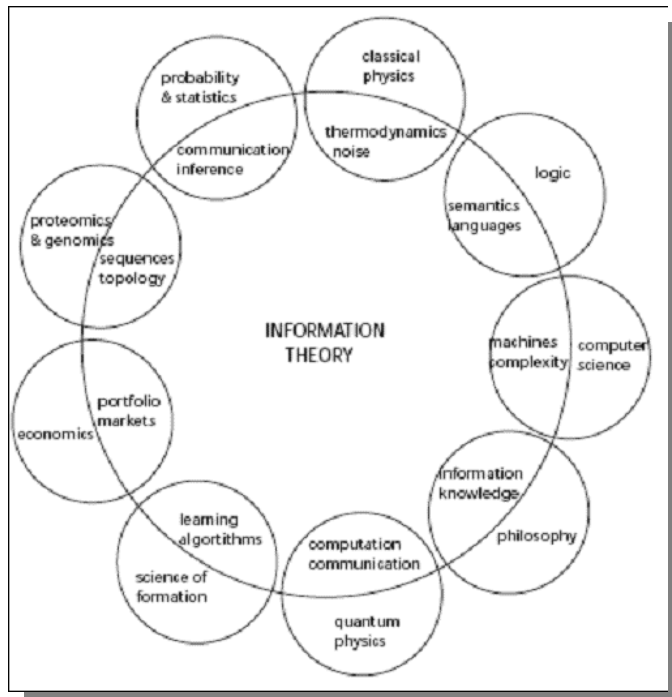
Figure 4 – A global overview of information theory and its links to different scientific discipline.

Communication Theory before Shannon

In the early 1940's the block diagram of a typical communication system (reflecting both

the implementation and the conceptual thinking) looked as follows:

```
+--------+          +-----------+          +-----------+
| Source |-------->| Modulator |-------->| Power Amp |--------\
+--------+          +-----------+          +-----------+        |
                                                                |
                                                                |
                                                                v
                                                       +---------+
                                          Noise ----->| Channel |
                                                       +---------+
                                                                |
                                                                |
+-------------+       +-------------+      +---------------+     |
| Destination |<-----| Demodulator |<-----| Front End Amp |<-----/
+-------------+       +-------------+      +---------------+
```
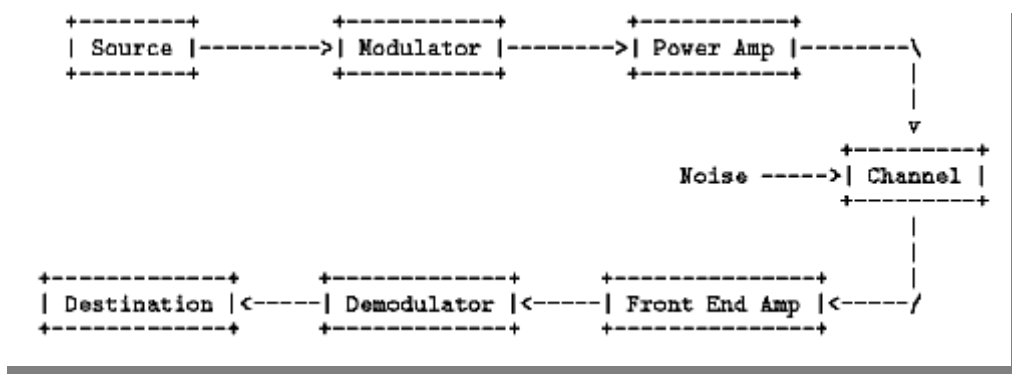
- The **source** is an analog signal such as music or voice, or in some cases the analog

voltage that drives some machinery like a teletype or photographic scanner.

- The **modulator** takes the original analog source signal and moves it to a location in

the frequency spectrum that is suitable for the communication channel.

- The **power amp** is the main "weapon" to combat the noise that is inherent in all

physical communication channels. To put it plainly, a communications engineer in the

1940s believed that the only way to improve transmission quality (at fixed rate) or

to increase transmission rate (at fixed quality) for a given channel was to crank up

the transmission power.

Shannon and Information Theory

Working on cryptographic systems during the Second World War (1939-1945), Claude E. Shannon at Bell Labs was led to the formulation of a **mathematical theory** of communications, which is now called **information theory**, which deals with the **fundamental aspects** of communication systems.

Shannon's theory for point-to-point communication systems can be summarized with the following conceptual block diagram:

```
+--------+              +---------+              +---------+
| Source |-------->| Source  |-------->| Channel |--------\
+--------+              | Encoder |              | Encoder |        |
                       +---------+              +---------+        |
Entropy H                                                          v
                                                         +-----------+
                                            Noise ----->| "Channel" |   Capacity C
                                                         +-----------+
                                                              |
                                                              |
+-------------+          +---------+              +---------+  |
| Destination |<-----| Source  |<--------| Channel |<-------/
+-------------+          | Decoder |              | Decoder |
                        +---------+              +---------+
```
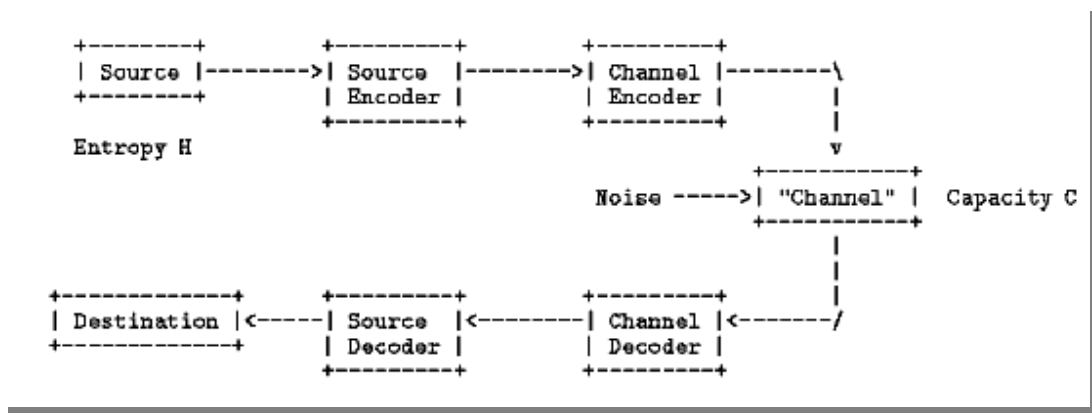
- The **source** is now either analog or digital and it is characterized by its **entropy H**.
- The raw output of the source is processed by the **source encoder.** Typical processing operations are sampling, quantization, and data compression. The goal is to produce the shortest faithful representation of the source output. The output of the source encoder is usually a string of bits.
- The **channel encoder** adds redundant symbols to the output of the source encoder, with the goal of enabling the channel decoder at the receiving end to reproduce the transmitted data reliably.
- The **"channel"**, (which we put in quotes to distinguish it from the physical channel in the previous block diagram), now consists of a modulator, power amp, physical waveform channel, receiver front end and demodulator. Most of the time the channel in this block diagram is considered to have discrete inputs and outputs. The channel together with the noise that disturbs the data transmission, is characterized by its capacity C.

Shannon's **main result**, which was quite a surprise for the communication theory community in the late 1940s, is that as long as H < C (i.e., source entropy is smaller than channel capacity), arbitrarily reliable communication is possible.

The novelty of Shannon's approach was:
1. the recognition that information, like the noise that disturbs the channel, is essentially **probabilistic** in nature, and

2. the conceptual focus on the role of source and channel coders and the question of their **existence** or non_existence for a given level of performance.

Practically speaking, Shannon's theory tells us that we should not rely on the the redundancy inherent in most sources to combat the noise on the channel. Rather, we should use a **source coder** to first remove all redundancy from the source signal. Then we should use a **channel coder** to add redundancy which is specifically designed to deal with a given channel and the noise by which it is affected.

What is the **price** that we pay? Before the existence of information theory, the price for more reliable communication was paid in the form of higher transmit power and/or reduced transmission rate. With the use of information theory, the price is paid in the form of **higher complexity** of the transmitters and receivers due to the source and channel coding operations.

How **practical** is information theory? Information theory is a mathematical theory with strong emphasis on probability theory. As such, it deals only with mathematical models and not with physical sources and channels.

Moreover, many of the results of information theory, e_g., **the channel coding theorem**, are purely existential in nature and thus not immediately implementable. However, information theory is an invaluable tool to guide us in the right direction and to shape our engineering intuition for the design and implementation of communication systems. A prime example of this is the assertion that the use of independent source and channel coding does not entail any loss in optimality of the overall system.

5.3.4. Introduction to Games Theory

"Life is a game whose first rule is: it is not a game".

Alan Watts

Games Theory is about the rational choices mechanisms in situations characterized by interdependence, namely those circumstances whose result, obtained by a competitor, depends or relies on the choices of other competitors which interacted with him and vice versa.

Subsequently the competitor, if rational, takes into account this state of things while deciding his own actions: namely he behaves strategically.

- Zero Sum Games (the loss of a competitor means the other's winning).
- Non Zero Sum Games (loss and win do not equalize).

Game theory is a branch of applied mathematics that is used in the social sciences (most notably economics), biology, engineering, political science, international relations, computer science (mainly for artificial intelligence), and philosophy. While initially developed to analyze competitions in which one individual does better at another's expense (zero sum games), it has been expanded to treat a wide class of interactions, which are classified according to several criteria. According to Aumann (1987) today, "game theory is a sort of "umbrella" theory for the rational side of social science, where "social" is interpreted broadly, to include human as well as non-human players (computers, animals, plants)[5].

Traditional applications of **game theory** attempt to find equilibria in these games—sets of strategies in which individuals are unlikely to change their behaviour. Many equilibrium concepts have been developed (most famously the Nash equilibrium) in an attempt to capture this idea. These equilibrium concepts are motivated differently depending on the field of application, although they often overlap or coincide. This methodology is not without criticism, and debates continue over the appropriateness

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[5] Aumann R.J. (1987): "Correlated equilibrium as an extension of Bayesian rationality", Econometrica 55, 1-18.

of particular equilibrium concepts, the appropriateness of equilibria altogether, and the usefulness of mathematical models more generally.

Although some developments occurred before it, the field of **Game Theory** came into being with the 1944 book *Theory of Games and Economic Behavior* by John von Neumann and Oskar Morgenstern. This theory was developed extensively in the 1950s by many scholars. Game theory was later explicitly applied to biology in the 1970s, although similar developments go back at least as far as the 1930s. Game theory has been widely recognized as an important tool in many fields.

The games studied in game theory are well-defined **mathematical objects**.
A game consists of a **set of players**, a **set of moves** (or **strategies**) available to those players, and a **specification of payoffs** for each combination of strategies. Most cooperative games are presented in the **characteristic function form**, while the extensive and the normal forms are used to define noncooperative games.

5.3.4.1. Types of game

Cooperative or non-cooperative

A game is cooperative if the players are able to form binding commitments. For instance the legal system requires them to adhere to their promises. In noncooperative games this is not possible.
Often it is assumed that communication among players is allowed in cooperative games, but not in noncooperative ones.
Of the two types of games, noncooperative games are able to model situations to the finest details, producing accurate results. Cooperative games focus on the game at large. Considerable efforts have been made to link the two approaches. The so-called Nash-programme has already established many of the cooperative solutions as noncooperative equilibria.
Hybrid games contain cooperative and non-cooperative elements. For instance, coalitions of players are formed in a cooperative game, but these play in a non-cooperative fashion.

Symmetric and asymmetric games

A **symmetric game** is a game where the payoffs for playing a particular strategy depend only on the other strategies employed, not on who is playing them. If the identities of the players can be changed without changing the payoff to the strategies, then a game is symmetric. Many of the commonly studied 2×2 games are symmetric. The standard representations of **chicken**, the **prisoner's dilemma**, and the **stag hunt** are all symmetric games.

Some scholars would consider certain asymmetric games as examples of these games as well. However, the most common payoffs for each of these games are symmetric.

Most commonly studied **asymmetric games** are games where there are not identical strategy sets for both players. For instance, the **ultimatum game**[6] and similarly the **dictator game**[7] have different strategies for each player. It is possible, however, for a game to have identical strategies for both players, yet be asymmetric.

Zero sum and non-zero sum games

Zero sum games are a special case of constant sum games, in which choices by players can neither increase nor decrease the available resources. In zero-sum games the total benefit to all players in the game, for every combination of strategies, always adds to zero (more informally, a player benefits only at the equal expense of others). Poker exemplifies a zero-sum game, because one wins exactly

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[6] The Ultimatum Game is an experimental economics game in which two players interact to decide how to divide a sum of money that is given to them. The first player proposes how to divide the sum between themselves, and the second player can either accept or reject this proposal. If the second player rejects, neither player receives anything. If the second player accepts, the money is split according to the proposal. The game is played only once, and anonymously, so that reciprocation is not an issue.

[7] The Dictator Game is a two player game in which the first player agent (the proposer) is given an amount of money, which it can share with the second agent (the receiver). The first agent decides on the percentage, which the second agent gets. The second agent makes no decision at all.
It is assumed that proposer agents give if they have a high genuine sense of fairness. If not, they would maximize their profit, by giving 0 to the receiving agent. Therefore, Dictator Game is a subclass of Fairness Game.

the amount one's opponents lose. Other zero sum games include **Matching Pennies**[8] and most classical board games including **Go**[9] and **Chess**.

	A	**B**
A	−1, 1	3, −3
B	0, 0	−2, 2
	A zero-sum game	

Many games studied by game theorists (including the famous **prisoner's dilemma**) are non-zero-sum games, because some outcomes have net results greater or less than zero. Informally, in non-zero-sum games, a gain by one player does not necessarily correspond with a loss by another.

Constant sum games correspond to activities like theft and gambling, but not to the fundamental economic situation in which there are potential gains from trade. It is possible to transform any game into a (possibly asymmetric) zero-sum game by adding an additional dummy player (often called "the board"), whose losses compensate the players' net winnings.

The prisoner's dilemma

The Prisoner's Dilemma constitutes a problem in *Game Theory*. It was originally framed by Merrill Flood and Melvin Dresher in 1950.

Albert W. Tucker formalized the game with prison sentence payoffs and gave it the "Prisoner's Dilemma" name.

In its "classical" form, the prisoner's dilemma (PD) is presented as follows:

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[8] **Matching pennies** is the name for a simple example game used in game theory. It is the two strategy equivalent of Rock, Paper, Scissors. Matching pennies, also called the *Pesky Little Brother Game* or *Parity Game*, is used primarily to illustrate the concept of mixed strategies and a mixed strategy Nash equilibrium. The game is played between two players, Player A and Player B. Each player has a penny and must secretly turn the penny to heads or tails. The players then reveal their choices simultaneously. If the pennies match (both heads or both tails), Player A receives one dollar from Player B (+1 for A, -1 for B). If the pennies do not match (one heads and one tails), Player B receives one dollar from Player A (-1 for A, +1 for B). This is an example of a zero-sum game, where one player's gain is exactly equal to the other player's loss.

[9] **Go** is a strategic board game and it is played by two players who alternately place black and white stones on the vacant intersections of a grid of 19×19 lines.

"Two suspects are arrested by the police. The police have insufficient evidence for a conviction, and, having separated both prisoners, visit each of them to offer the same deal. If one testifies ("defects") for the prosecution against the other and the other remains silent, the betrayer goes free and the silent accomplice receives the full 10-year sentence. If both remain silent, both prisoners are sentenced to only six months in jail for a minor charge. If each betrays the other, each receives a five-year sentence. Each prisoner must choose to betray the other or to remain silent. Each one is assured that the other would not know about the betrayal before the end of the investigation. How should the prisoners act?"

If we assume that each player prefers shorter sentences to longer ones, and that each gets no utility out of lowering the other player's sentence, and that there are no reputation effects from a player's decision, then the prisoner's dilemma forms a non-zero-sum game in which two players may each "cooperate" with or "defect" from (i.e., betray) the other player. In this game, as in all game theory, the only concern of each individual player ("prisoner") is maximizing his/her own payoff, without any concern for the other player's payoff. The unique equilibrium for this game is a Pareto-suboptimal solution — that is, rational choice leads the two players to both play defect even though each player's individual reward would be greater if they both played cooperatively.

In the classic form of this game, cooperating is strictly dominated by defecting, so that the only possible equilibrium for the game is for all players to defect. In simpler terms, no matter what the other player does, one player will always gain a greater payoff by playing defect. Since in any situation playing defect is more beneficial than cooperating, all rational players will play defect, all things being equal.

In the iterated prisoner's dilemma the game is played **repeatedly**. Thus each player has an opportunity to "punish" the other player for previous non-cooperative play. Cooperation may then arise as an equilibrium outcome. The incentive to defect is overcome by the threat of punishment, leading to the possibility of a cooperative outcome. So if the game is infinitely repeated, cooperation may be a **subgame perfect Nash equilibrium** although both players defecting always remains an equilibrium and there are many other equilibrium outcomes.

In casual usage, the label "prisoner's dilemma" may be applied to situations not strictly matching the formal criteria of the classic or iterative games; for instance,

those in which two entities could gain important benefits from cooperating or suffer from the failure to do so, but find it merely difficult or expensive, not necessarily impossible, to coordinate their activities to achieve cooperation.

Simultaneous and sequential games

Simultaneous games are games where both players move simultaneously, or if they do not move simultaneously, the later players are unaware of the earlier players' actions (making them effectively simultaneous). Sequential games (or dynamic games) are games where later players have some knowledge about earlier actions. This need not be perfect information about every action of earlier players; it might be very little knowledge. For instance, a player may know that an earlier player did not perform one particular action, while he does not know which of the other available actions the first player actually performed.

Perfect information and imperfect information

An important subset of sequential games consists of games of **perfect information**. A game is one of **perfect information** if all players know the moves previously made by all other players. Thus, only **sequential games** can be games of perfect information, since in simultaneous games not every player knows the actions of the others. Most games studied in game theory are **imperfect information games**, although there are some interesting examples of perfect information games,

including the **ultimatum game** and **centipede game**[10]. Perfect information games include also **Chess, Go, Mancala**[11]**,** and **Arimaa**[12].

Perfect information is often confused with **complete information**, which is a similar concept. Complete information requires that every player know the strategies and payoffs of the other players but not necessarily the actions.

Infinitely long games

Games, as studied by economists and real-world game players, are generally finished in a finite number of moves. Pure mathematicians are not so constrained, and set theorists in particular study games that last for an infinite number of moves, with the winner (or other payoff) not known until after all those moves are completed.

The focus of attention is usually not so much on what is the best way to play such a game, but simply on whether one or the other player has a winning strategy. (It can be proven, using the axiom of choice, that there are games—even with perfect information, and where the only outcomes are "win" or "lose"—for which neither player has a winning strategy.) The existence of such strategies, for cleverly designed games, has important consequences in descriptive set theory.

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[10] In game theory, the **centipede game**, first introduced by Rosenthal (1981), is an extensive form game in which two players take turns choosing either to take a slightly larger share of a slowly increasing pot, or to pass the pot to the other player. The payoffs are arranged so that if one passes the pot to one's opponent and the opponent takes the pot on the next round, one receives slightly less than if one had taken the pot on this round. Although the traditional centipede game had a limit of 100 rounds (hence the name), any game with this structure but a different number of rounds is called a centipede game. The **unique sub-game perfect equilibrium** (and every Nash equilibrium) of these games indicates that the first player take the pot on the very first round of the game; however in empirical tests relatively few players do so, and as a result achieve a higher payoff than the payoff predicted by the equilibria analysis. These results are taken to show that **sub-game perfect equilibria** and **Nash equilibria** fail to predict human play in some circumstances. The Centipede game is commonly used in introductory game theory courses and texts to highlight the concept of backward induction and the iterated elimination of dominated strategies, which provide a standard way of providing a solution to the game.

[11] *Mancala* is a family of board games played around the world, sometimes called "sowing" games, or "count-and-capture" games, which describes the game-play. *Mancala* games play a role in many African and some Asian societies comparable to that of chess in the West.

[12] **Arimaa** is a two-player abstract strategy board game that can be played using the same equipment as chess. Arimaa has so far proven to be more difficult for **artificial intelligences** to play than chess.

Discrete and continuous games

Much of game theory is concerned with finite, discrete games, that have a finite number of players, moves, events, outcomes, etc. Many concepts can be extended, however. Continuous games allow players to choose a strategy from a continuous strategy set. For instance, **Cournot competition**[13] is typically modeled with players' strategies being any non-negative quantities, including fractional quantities.

Differential games such as the continuous pursuit and evasion game are continuous games.

Metagames

These are games the play of which is the development of the rules for another game, the target or subject game. Metagames seek to maximize the utility value of the rule set developed. The theory of metagames is related to mechanism design theory.

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[13] **Cournot competition** is an economic model used to describe an industry structure in which companies compete on the amount of output they will produce, which they decide on independently of each other and at the same time. It is named after Antoine Augustin Cournot (1801-1877) after he observed competition in a spring water duopoly. It has the following features:
-   There is more than one firm and all firms produce a homogeneous product, i.e. there is no product differentiation;
-   Firms do not cooperate, i.e. there is no collusion;
-   Firms have market power, i.e. each firm's output decision affects the good's price;
-   The number of firms is fixed;
-   Firms compete in quantities, and choose quantities simultaneously;
-   The firms are economically rational and act strategically, usually seeking to maximize profit given their competitors' decisions.

5.3.5. Introduction to Chaos Theory

Chaos Definitions

- Casual behaviour occurring in a deterministic system.
- Sensitivity to the initial conditions: major changes has not necessarily major causes.
- Chaos Geometric Action: stretching and bending.
- Existence of infinite repulsive cycles.
- Chaos is about phenomena, considered predictable, that are partially developing in a way not predictable but classifiable and investigable.

Within the Chaos Theory framework even the most complex dynamics respond to pre-set mathematical equations whose effects are immutable and not adaptable.

Chaos is neither casualness or disorder but a complex order.

A deterministic dynamic system is called *"chaotic"* if its dynamic is ruled by a peculiar mathematical entity called *"strange attractor"*. A chaotic system peculiar feature is the apparent unpredictably of the system trajectories, due to the strong sensitivity to the initial conditions: a small error in knowledge about a certain instant state of the system may cause even major errors in medium and/or long terms predictions.

Chaos is more important than order.

Nature uses **Chaos** as an integrating part of its evolutionary planning.

To solve the problem of adaptation of life in order to survive in a constantly changing, really complex and apparently chaotic environment, every deterministic plan should be destined to failure.

Therefore Nature chooses to fight the Chaos through the Chaos itself, generating through adaptive mutations a multitude of life forms.

Chaos Theory suggests that not always is possible to predict the long term effects of our actions and it is better to be open minded and flexible.

As Nature survives through bio-diversity, having a variety of ideas and approaches becomes fundamental.

When a road is closed, Nature has got many other paths to choose.

That should teach to complex organizations that an excessive specialization leads to degradation and eventually to death.

<u>Tool to understand Chaos</u>

Mathematics is the most efficient and reliable method to understand what surrounds us.

Newton's Mathematical Laws on Motion relied on *differential equations,* namely equations that involve certain quantities and the velocities which these quantities vary by (differences among values in close instants of time).

<u>Tool Properties:</u>

Existence and uniqueness of the solution.

Classic Deterministic Paradigm: *"if equations describe a system evolution in a unique way, with no external casual contribution, the system behavior is forever specified in a unique way.*

<u>Order and Chaos interlace</u>

"Simple non linear systems do not necessarily have simple dynamic properties" (May, 1976)

Order and Chaos appear as two distinct manifestations of a below determinism.

Harmony and dissonance coexist.

Casualness does not depend on external noise factors but it is an intrinsic property of the systems.

An important contribution to the Chaos Theory development was given by Henri Poincaré (1854-1912).

He is the founder of the Qualitative Theory of Dynamic Systems, that is a kind of analysis of the motion laws that is based on geometric-visual methods.

He did not care anymore about the formal solution of an equation rather he tried to define whether this solution is stable or not.

The solar system obeys to the deterministic laws of physics, therefore its planets motion is unique, but is this motion stable?

As a matter of fact Laplace's vision ("*by knowing how all the parameters vary we can describe all the universe evolution"*) is right both in linear systems and in not linear ones, as long as far away from chaotic behaviors regimes. But in non linear models, even simple ones, the trajectories may result very similar to *aleatory states*

series, namely obtained by the intervention casual elements (such as the results in dice rolling).

Attractors

In the long term a dynamic system stabilizes toward an ***attractor***.

On a surface the only possibilities are:

- Singular point (stay still!)
- Limit Cycle (oscillate!)

Other contributions

Important contributions to the Qualitative Theory of Dynamic Systems were given by the great Russian School in the thirties, by Lyapunov, Kolmogorov, Andronov, Pontrjaguine and by Birkhoff's studies in the USA.

In 1963 the American meteorologist Edward Lorenz and the British physicist Edward May[14] in 1976 gave major contributions to the spread and the increasing popularity of this Mathematical sector.

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[14] May, R.; "Simple mathematical models with very complicated dynamics" in *Nature* **261**, 459 - 467 (10 June 1976)

5.3.6. Introduction to Catastrophe Theory

Catastrophe Theory[15] shows how in mathematical dynamic systems, even the simple ones, the observed changes may be continuous and gradual deformations of the previous state but, in a critical stage, the overall system shape undergoes a "catastrophic" change and continues its own development into a new shape.

Chaos and Catastrophes are intimately linked.

Catastrophes (and Chaos too) describe sudden **changes** and **phase transitions** among qualitatively different situations of structural stability.

One should identify in which conditions the system will behave in a chaotic or catastrophic way.

These information are more important than the exact knowledge of the future system evolution. Indeed we can eventually act on the external parameters of the system, and regulate them in order to avoid chaos and catastrophes.

The Catastrophe Model has been used even to descrive nutritional disorders, such as bulimia or anorexia. The "catastrophe" depends on several control factors that determine and drive regular or sudden transition phases.

For instance in the "Anorexia Cycle", the *"catastrophe of let yourself go"* follows the *"fasting"* and the *"purging"* phases and it is then followed by an *"overeating"* phase, and then again "fasting-purging-catastrophe-overeating" in a vicious circle.

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15 Thom R., "La stabilité topologique des applications polynomiales" Enseign. Math. , 8 : 2 (**1962**) pp. 24–33.

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Chapter 6

Match Analysis Procedures

6. Match Analysis Procedures

As already mentioned in this thesis (Chapter 2), match analysis procedures are becoming increasingly more sophisticated and complex, mirroring quite closely the rapid developments in technology.

Whilst computerized systems can potentially reduce the workload involved in analysing matches and enable information to be stored in databases, often with accompanying video footage, such systems are nonetheless still very expensive and remain an option for only the wealthiest clubs or sport federations. At date, **cheaper systems** are slowly coming into the market, but their reliability and consistence are still not scientifically proved. Nevertheless many Analysts are actually working, even at international level, using these systems, providing an enormous amount of data to the coaches. Of course further and deeper researches are needed.

Fortunately manual, hand-based notation systems can be developed very easily, providing answers to questions posed by the majority of coaches. Such notation systems are cheap (they use pen and paper) and adaptable (they can be personalized for a coach's own requirements), and simple data sets are readily available for dissemination.

In this chapter we provide an introduction to manual notation systems, illustrating how they can be developed and evaluated. We provide also a global overview on Video Analysis and more sophisticated systems of Match Analysis.

There are typically four stages involved when using a hand-based notation system:

1. deciding what information is needed and why,

2. designing the hand-based notation system,

3. checking on the accuracy of the data,

4.   collating and presenting the findings.

Deciding what information is needed and why

It is essential that coaches spend sufficient time considering what information is needed and why. A well-designed system provides the coach with accurate and reliable information that is easily gathered and has an impact on subsequent practice and performance. The information should be of value such that there is a **clear link between the analysis undertaken and the coaching process**. This is the most important guiding principle to help coaches avoid wasting valuable time and resources. Although

different data can be collected from one game to the next, it is vital for this information be integrated within the coaching process.

The match analysis process should provide information about how a team or individual has performed such that it aids the coaching process and helps facilitate performance.

If coaches are unable to use this information, whether on the training field or in the dressing room, it is of no practical value. Systems should be developed relative to the specific coaching process that they are intended to support.

The information must match the purpose for which it is intended.

Objective data can help resolve this issue, providing coaches with information to enable him/her to design suitable practice sessions in an attempt to rectify the problem(s).

Finally, in addition to having a clear understanding of the information to be notated, it is important to consider the information that the coach has decided not to notate or is for one reason or another unable to notate. The omission of certain information may create a somewhat incomplete picture. The process of developing an effective manual notation system is about **recognising what information will be ignored or missed by the observer as much as it is about identifying what will be recorded**.

Clearly, if the coach is without access to all pieces of the puzzle, the picture may be incomplete, increasing the likelihood that the match analysis system will be ineffective. The key issue is that coaches should consider what is and what is not being measured when designing the notation system and evaluating the usefulness of the data.

6.1. Research and Observation: Applied Methodologies

How to design a hand-based notation system

The most commonly employed systems are pen and paper based. These involve a form of shorthand notation of specific match features. Such notation may be undertaken as the match progresses, or immediately after the match if access to a video recording is possible. The quantity of information required by the coach determines whether this is best coded during or after the match. One or more observers may be used to code the same or different features of the match, and the coding may be undertaken by one of the substitutes, the coaching or backroom staff, or a relative or friend, provided that they have some degree of familiarity with the system and understand what specifically needs to be notated. The coach and analyst(s) need to have a clear and shared picture of the information required and how this is to be notated. The analyst should initially experiment with a few ideas on paper, undertake several 'live' trials and gradually refine the system

until satisfied. The complexity of the system should be increased in logical and easy stages. Refining of the system or adding new bits of information should not take place until the analyst is fully satisfied with how well the system is operating and only after feedback has been obtained from the end-user.

It is also important to understand that there is a wide range of performance actions and outcomes in sport, and they tend to follow a logical path. This means that when a coach or analyst is collecting statistical data, the process must be structured to allow for or limit the many different possibilities. For example, a pass can be classed as being successful if possession is retained and unsuccessful if possession is lost. The pass can also be further broken down into long/medium/short, in the air/on the ground and favoured/non-favoured foot (see chapter 9).

A sequence of play can include many different actions such as passes, controls, dribbles, shots, saves and clearances. These action sequences can be recorded using a logical structure within the match analysis system. As they can and often do vary, it is useful to think about creating a structural model in order to define all the possible action types and outcomes in order not to miss any data. For example, Figure 6.1) demonstrates a player who is just about to come into possession and shoot at goal (Carling et al., 2005). This example shows how a simple action can become complicated as a result of all the possibilities and outcomes. The figure also strengthens the argument that the initial choice of data to be recorded is essential. The analyst first records the player's name, position and time (see further on in the chapter for more information on these core elements). The action type is then noted; in this example, either the ball is controlled or a first-time shot is made. If a ball control is attempted, then the action's outcome is recorded. For example, if possession is lost (e.g. through a tackle), then the process starts again, or if the ball control is successful then the player will shoot (and again at least the position and time should be recorded, as a new action is now taking place) and the outcome of the shot will then be analysed. If the player decides to shoot first-time after receiving possession, the outcome of the shot must then be noted, as either on target (e.g. goal, save) or off target (e.g. wide, high). Whatever the outcome, the process will start again (e.g. if the ball is saved and goes out for a corner, the goalkeeper, position and save plus action time will be notated).

The basic components in almost every match analysis system are player, action and position. More sophisticated systems may also measure time and sequences of events.

Figure diagram

PLAYER

POSITION

TIME

ACTION

CONTROL ← → **SHOT**

POSSESION LOST   **POSSESION KEPT**   **OFF-TARGET**   **ON-TARGET**

SHOT

WIDE   **GOAL**

HIGH   **SAVE**

BLOCKED   **WOODWORK**

BLOCKED
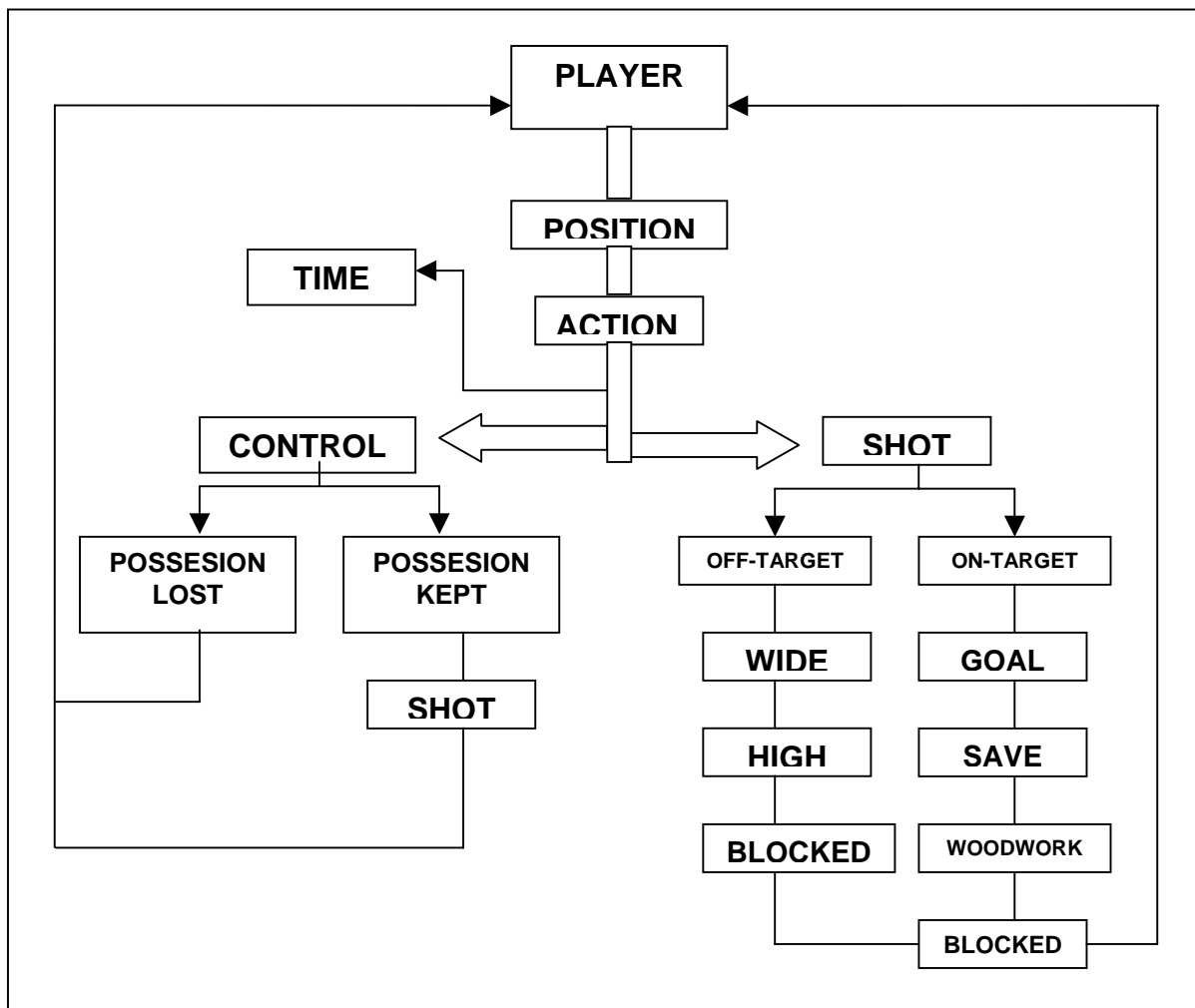
Figure 1 – The analysis process for a shot at goal (Carling et al., 2005)

Player

It is often necessary to know which player performed specific actions. When a hand-based notation system or tally sheet is being designed, every player may need to be included on certain occasions. For example, when a coach is attempting to determine why the team loses possession of the ball too frequently, it may be useful to record the pass success rate of all players. At other times, a coach may only be interested in a specific player or group of players and consequently the analysis process is simplified markedly. For example, if a coach is mainly interested in the number of crosses that the team played into the penalty area, then only data for the wide-midfield players and fullbacks may be required. Similarly, a coach interested in the team's perceived weakness in the air at the

back may only require information on the headers won or lost by the two centre-backs (see chapter 9, section 8).

Action

A range of actions can be recorded such as passing, attempts on goal, crossing, tackles and heading, depending on the interests of the coach. It may also be necessary to record the consequence of each action (e.g. successful or unsuccessful pass or cross, shot at goal - on or off target). This latter consideration can actually be a fairly difficult process. For example, how does one define a "successful" pass or cross? Is a successful pass one that reaches a team-mate or does the pass also have to be weighted in such a way that the player can control the ball without altering his/her running stride? What is the difference between a successful, yet safe pass to a team-mate in the midfield area and a risky, yet unsuccessful pass that almost creates a goal-scoring opportunity in the final third? Such issues need to be clarified in advance, so that both the analyst and the person interpreting the data are consistent in their definition of key terms (see chapter 9, section 8).

Tally chart tables can also be employed by coaches to collect data for player actions based on a "success/failure" index.

 A simple tally sheet (Table 1) is used to record frequency counts of unsuccessful and successful actions. At the end of the match, the analyst counts -1 point for each unsuccessful action and +1 point for each successful action. Care should be again taken, as some of these actions may involve personal interpretation, especially if specific match criteria are not clearly defined. In this example, a defender scored an index of 9 (24-15) and this can be compared over several matches to look at performance consistency and identify various strengths/weaknesses.

	Successful actions	*Unsuccessful actions*
Tackle	√√√√√√√√√	√√
Header	√√√	√√√√√
Interception	√√√√	√
Clearance	√√√√	√√
Free Kick (won/conceded)	√√√	√√√√√
Total	+24	-15

Table 1 – A simple tally sheet to record frequency counts to create a success/failure index (Carling et Al., 2005)

Specific parts of performance can also be assessed by observing and recording other factors. For example, the number of shots on target or number of crosses played into the

penalty area by the opposition may provide the coach with information on his/her team's defensive strengths or weaknesses. Similarly, an analysis of the number of counter-attacks launched against his/her team may tell the coach something about the team's susceptibility to this method of attack. Studying the opposition can often provide a coach with as much, if not more, information than analysing his or her own team.

Position

Coaches often need to know where on the pitch the action occurred. For example, the fact that the opposing team played ten crosses into the penalty area may be less important than finding out what area of the field these crosses were played from. Positional data may be recorded by breaking down the pitch into numbered zones or cells, as highlighted in Figure 2. Alternatively, coaches can use a schematic of the pitch and mark on this diagram where each event (e.g. cross) took place.
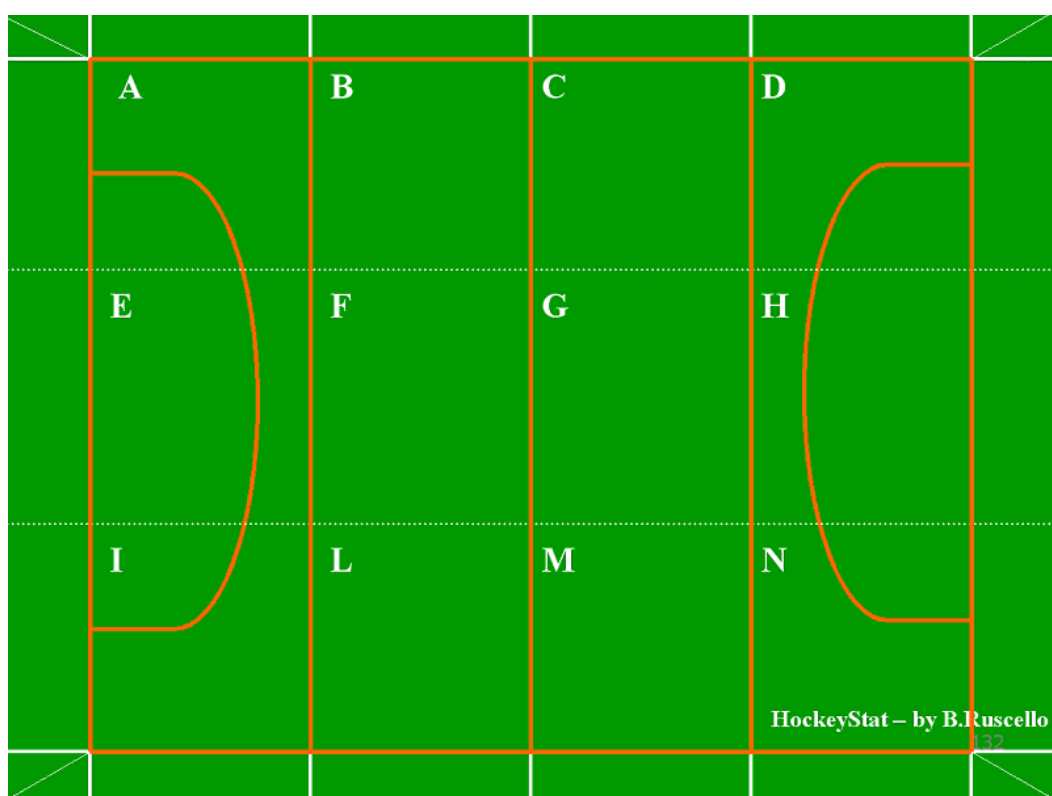
Figure 2 – A schematic of the Hockey pitch divided into sectors (Ruscello, 1984)

The more complex the data, the longer they take to collect and process, so observers should record only what is needed. Coaches should resist the temptation to code everything. Simple notation systems that focus on a small number of actions that are relevant to the coach are of greater value than those that produce reams of data - **more is not always better**, so far as match analysis is concerned. Moreover, a well-designed system will only provide the

information that it was intended to produce; it does not guarantee success, and the art of coaching is that of interpreting and applying the information in the most appropriate manner (Carling, et al., 2005).

In determining the most appropriate method for recording data the coach must consider:

- the attention required to make an entry onto the sheet;
- the speed with which data can be entered;
- the ease of collating the information at the end of the analysis;
- whether both teams can be analysed by the same person.

Time and sequence

Coaches may sometimes be interested in the time course of events. For example, a team may be conceding goals late in the game, and consequently a coach may wish to determine whether the team loses possession of the ball in the final third more frequently in the final 15 minutes of the match or whether there is a drop in the number of challenges being won in that area of the pitch. The coach may divide the game into varying time segments depending on the question of interest. Data can be collated for each half, every 15 minutes or for the last 10 minutes of the match only. Table 2 provides an example of a notation sheet where key match actions are grouped in 15-minute periods.

Time period (mins)	Lost possession	Lost challenges
00-15	√√√	√√√
16-30	√√√√	√√
31-45	√√	√√
46-60	√√√√	√√√
61-75	√√√√√	√√√√√
76-90	√√√√√√	√√√√√

Table 2 – Frequency count to indicate the number of times the team gives the ball away through a bad pass (lost possession) and loses a tackle or header (challenges). (Carling et Al., 2005)

Several coaches or sport sciences scholars have proposed more sophisticated notation sheet over time (e.g. see Howard Wilkinson's work as Technical Director of the UK Football Association in recent years).

The types of analysis proposed could potentially, after some training, be notated in real time as the match evolves, thereby providing access to collated information at various times during (e.g. half-time) and immediately after a match.

Determining the accuracy and reliability of the data

Some of the classifications employed may be fairly subjective (e.g. successful or unsuccessful cross, long or short pass, dribble or run with the ball) and coaches need to provide clear definitions to indicate, particularly for other observers, what they mean by each category of action. Even so, there is still considerable scope for error in observation and coding. In particular, there is evidence to indicate that an observer's expectation of what he/she expects to see can alter the nature of the coding process (Hughes and Francks, 2004). Also, an observer's definition of a specific event may drift or alter over time.

To ensure that the data are objective and reliable, it is helpful to ask another coach to analyse the same match simultaneously (Darst et al., 1983). Alternatively, if video footage is available, coaches can review various aspects of the match themselves to ensure accuracy and reliability of the data. It may be useful to compare the real-time notation of the match with that undertaken post-match using the recorded video footage. If time is limited, this can be done for only a portion of the match (e.g. "Time Sampling" in Darst et al., 1983). Whilst it is not necessary to undertake such procedures every match, it is useful to consider such issues when developing a new notation sheet or when employing a different observer. Once observers have been trained and are familiar with the notation sheet and the agreed-upon definitions of each action, and good agreement has been obtained across observers or for the same observer coding part of the same match, then agreement checks may be carried out less frequently.

Collating and presenting the data

Once the data have been collected, they need to be collated and presented in a simple, easy-to-understand format, particularly if a number of coaches need to access the information. Coaches with a reasonable background in computing can transfer the information contained on the hand-based notation sheet to a data analysis software package such as Excel, thereby reducing the time required to summarise aspects of the data. Coaches without such technical training should try to collate the data as best they can by calculating mean frequency scores and presenting this information in summary tables or in graphical format. The intention is to ensure that other coaches and players can easily access the data. These issues are considered in Chapter 12.

6.2. Technical Issues in Match Analysis

Skill acquisition may be characterised as an active "cumulative" process during which a target movement is expected to improve as a function of practice. Only when the performer is able to reproduce a desired pattern systematically and in a satisfactory way can the motor skill be considered as finally acquired. Feedback shortens and improves the acquisition process, but only if appropriately administered (Schmidt and Lee, 1999). Recent advances in information technology have exploited this fact, and focused on the feedback athletes receive during training or even during competition.

Feedback is a concept that originated in control theory for close-loop systems (Shannon and Weaver, 1949) designed to keep homeostasis or equilibrium around a reference value a priori set. Such systems are designed to sense information about their actual state, and if any differences between actual and reference values appear, they are corrected in order to restore homeostasis. Motor control in humans is far more sophisticated but, as a conceptual framework, close-loop theory has had very practical implications for motor skill acquisition: firstly, concerning the use of feedback in motor learning, and secondly, concerning the development of specific technologies applied to sports.

Coaches have long assumed their role as feedback facilitators, but they recognise to a lesser extent their role in the correct administration of feedback (its type, quantity and frequency). It is in their power to decide if and how to integrate feedback-based technologies into their training protocols. Some of these technologies allow augmented feedback to be managed by the coach, thus enriching the training experience by stimulating diverse sensory modalities. Such technologies are worth mentioning and are described in the present chapter. Their advantages and disadvantages are discussed along with practical examples on how augmented feedback, in combination with latest advances in technology, can be used to enhance motor performance skill acquisition.

Video information as a source of feedback

During training, athletes are active in correcting errors in performance and normally use different feedback sources, such as vision and proprioception. On some other occasions, however, they are passive. The question of concern here is to what extent feedback is effective when an athlete is a passive observer: for example, when coaches use alternative training aids such as videotaped replays of previous performances.

Extrinsic video information without a coach's guidance would be rather ineffective in many cases. Video technology has significantly influenced training methods mainly

because its relatively low cost, accessibility and portability had already made it the most popular technology among coaches in many sporting events. Individuals watching their performances on videotape cannot regulate the feedback they receive, and sometimes the information available might exceed the athletes' processing ability. Therefore, the intervention of a coach is required, particularly with inexperienced or young athletes. Coaches could help in pinpointing the relevant information captured on video. Then, they could use it as feedback that would help the performer to associate errors in perform-ance, their correction, and the expected movement pattern. From videotaped replays coaches may extract two main kinds of feedback information: one relating to qualitative aspects of performance, and the other relating to the quantitative information. The relation of these two types of video feedback and other technologies will be described in the following paragraphs.

Qualitative video feedback

Video is mostly recognised as an appropriate medium for obtaining qualitative information about performance. Video in combination with TV and PC technology is suitable for enhancement of feedback during the replays. A very promising use of video replays is related to playback technology that allows for a comparison between one's performance and that of other athletes. The technology may be used to imitate movements. One remarkable fact of comparison and imitation is that, as a learning strategy, it has behavioural and neurobiological basis. Humans and other primates imitate movements soon after birth (Meltzoff and Moore, 1977). Moreover, there is evidence showing that specific neurons in the pre-motor cortex of the brain (an area highly associated with planning motor acts) are responsive to movements of others (mirror neurons) as well as to motor actions carried out by the observer (Rizzolatti et al., 2001). A possible benefit of visually imitating and comparing movements is that imitation is based on observable (extrinsic) kinematics. This strategy might actually serve to bypass the computational burden imposed on the brain during planning motion because it need not consider movement dynamics (muscle moments and joint torques) during computation (Wolpert et al., 1995). This has obvious practical implications for machine learning. In this area of research, imitation is effectively implemented to accelerate robot motor learning (see Schaal, 1998, 1999).

In sport, software developed for implementing the imitation strategy is available. One such technology enables a user to split the computer screen in two halves, and observe in one half the actual performance and in the other half the model performance. The same technology enables a user to blend two synchronized video footages, one from an expert and another from a less experienced individual, which are enhanced, fitted to each other

and appropriately transformed (scaled, translated and rotated) (www.quintic.com; www.dartfish.com). To extract meaningful visual information, the videotaped performances can be viewed as continuous replays or as single frames (one frame after an other). Digital blending may be more useful to expose essential differences between two performances, and therefore it may lead to a more effective use of visual feedback. A drawback in comparing and imitating the performance of an expert athlete is that no two performers are identical. What is optimal for one athlete is not for another (Bartlett, 1999). Therefore, the general use of superposition of videotaped replays should be carefully examined in each case. For example, mechanical demands are maximized only at high competitive levels, and therefore mechanical solutions are constrained to only a few, of which some are worth imitating. At low competitive levels, it is suggested to use this technology only to compare video-recorded movements of one's own performance in repeated trials during training or even during competition. For beginners, such visual feedback may be ineffective if the coach does not guide the performer about the interesting foci of attention.

Quantitative video *feedback*

Relevant feedback about the performance is sometimes less explicit than that provided by just showing a videotaped replay. Quantitative information about segmental and joint kinematics (paths, velocities and accelerations) can sometimes provide the basis for changes and corrections based on objective and comprehensible data. For example, vector graphics describing the direction and magnitude of a movement (e.g. the ball path and velocity in a football match) are easily captured today using event-tracking software combined with video or TV technology (www.orad.co.il/sport/index.htm). Basic kinematic information may be used on site or in remote locations for immediate notational analysis if TV broadcasting is available.

When the kinematic feedback needs to be more specific (e.g. joint rotations), the appropriate video technology is different. Video cameras are required to record on-site both the performer in action and a calibration frame of known dimensions, and from a constant perspective. It also requires suitable means for offline video projection, and software to extract digital information and analyse the data. Most video systems for movement analysis require manual coding and visual detection of points of interest on the single images (video frames or fields), one at a time. A data transformation process follows to convert video-coded images in pixel units to some real unit. Displacements as a function of time could therefore be obtained and higher-order time derivatives (e.g. segmental velocities) could be calculated (see Ariel Dynamics, Inc., www.arielnet.com for illustrative examples). Common video analysis systems have become affordable for coaches, and are adaptable to most PC platforms and video cameras. However, a

disadvantage of such kinematic analysis systems is that detection of points on the computer screen is manual. This is rather tedious work, and without the expertise, it may sometimes result in unreliable data. Another disadvantage of most affordable commercial systems is their low frame rate, normally ranging between 50 and 60 Hz for European PAL or North American NTSC systems, (0.02s or 0.016s between frames respectively). At these sampling rates, important fast events might not be captured (e.g. the exact moment of heel-strike during running). Although such systems are costeffective, the quantitative feedback that finally reaches coaches and athletes is delayed with respect to the time of performance. The time taken to record manually the specific points of interest can be rather long (Ay and Kubo, *1999),* and this precludes immediate feedback of anything other than the video images themselves. Because of the delay in the provision of the quantitative feedback, videotaped performances cannot always be associated with the internal sensory experience at the time of motor execution. To solve this problem, automatic or semi-automatic video-based commercial systems for movement analysis have been developed and are available. They allow the same information to be gathered more easily and immediately, but are significantly more expensive.

Automated systems as a source of complex information

Immediate and detailed kinematic analyses require fully automated and technical expertise. Automatic tracking systems use different technologies to track and record motion events in real time (e.g. Charnwood Dynamics, Inc., www.charndyn.com, Motion Analysis Corp., www.motionanalysis.com, Optotrak - Northern Digital Ltd, www.northerndigital.ca , ProReflex and QTM - Qualisys Ltd, www.qualisys.se, Vicon - Oxford Metrics Inc., www.vicon.com). Most are not based on video, but are optic systems adapted to capture light, either passively from light-reflecting markers or actively from pulsed light arrays synchronised with multiple cameras. They are particularly attractive for rapid feedback provision in non-competitive sport settings and for analysing fast motion. Their development has been parallel to that of computer technology that facilitates the task of computation, and to computer vision that allows automatic recognition of markers. The feedback information that can be provided to the athlete is almost immediate and may touch most important aspects of movement. The appropriate way to exploit such technologies is to focus only on the relevant kinematic parameters that answer specific questions because the information that can be retrieved using such systems is too large. This approach accompanied the development of the technologies, and became popular during the past decade to bring athletes to maximal performance (Kearney,1996).
However, most automated systems do not work on video images, and only work on selective marker information. Only a few systems allow video image collection in parallel with marker

data collection. Usually these systems are only adapted to combine video recording with the automatic marker recording from separate cameras, all synchronised at start, but not necessarily working at the same sampling frequency. To compensate for the lack of video recording, some other systems combine marker data with simulations of the performance. The assumption is that a virtual performer would add some realism to the numerical marker data, and thus they put an emphasis on the translation of the real-time marker positions into solid body models by using appropriate software packages and body scanning technology. It should be noted that any advantage of receiving feedback from three-dimensional graphics (compared to only two-dimensional simple video replays) during training or competition is not well documented. It appears that systems that can overlap real video with the solid body models may become a choice of preference of coaches and athletes, because these systems combine the advantage of video with quantitative data and simulations.

6.3.   A Comparative Analysis of current commercial software

As technology is constantly changing, it is important that coaches are familiar with the latest match analysis systems and what type of information they can provide. Table 3 provides a list of current systems. There are three major types of systems now available on the market, all developed using the very latest cutting-edge technology and having benefited from the practical input and knowledge of top-level coaches.

The systems work on either a real-time or a post-match basis. Real-time analysis allows the match to be analysed `live' as the events unfold. This requires high skill levels acquired through training and experience. The data are instantaneously available for the coach to use either during the match, at half time or for immediate feedback after the game. A match analyst working in real time can analyse performance either through a "live" video recording or simply by watching the match from the stands. Post-match systems involve the match being analysed after it has finished. Such analysis requires the use of a video recording to input data. The advantage of post-match analysis is that the footage can be played back more than once or slowed down. Any doubts or mistakes can be easily rectified by the analyst. Video and statistical-based analysis systems which do not track player movements can be employed on either a real-time or a post-match basis. Electronic player tracking systems are generally based on real-time analysis whereas computerised tracking systems work post-match. However, if only one or two players are tracked, then real-time analysis is possible. Depending on the system, the delay before the results are available can be relatively short. It can be a few hours, though semi-automatic computerised player tracking systems require a day or two.

	Manufacturer	Country	Software	WEB site
1	Dartfish	Swiss	Dart Trainer	http://www.dartfish.com
2	Elite Sport Analysis	UK	Focus X2	http://www.elitesportanalysis.com/
3	MasterCoach Int. GmbH	Germany	MasterCoach	http://www.mastercoach.de
4	Pinnacle System	USA	SportsEdit	http://www.pinnacleteamsports.com
5	PosiCom AS	Norway	Posicom	http://www.posicom.no/
6	REM Informatique	France	StadeXpert	http://www.af-d.com/
7	Scanball	France	Scanfoot	http://www.scanball.com/
8	Softory/Sportweb	Denmark/Germany	Matchanalyzer	http://www.matchanalyzer.com
9	SoftSport Inc	USA	SecondLook	http://www.softsport,com/
10	Sportstec	Australia	SportsCode	http://www.sportstecinternational.com
11	Sport-Universal SA	France	AMISCO Pro Video Squencer	http://www.sport-universal.com
12	Digital Soccer Project	Italy	Digital Soccer	http://www.digitalsoccer.it/
13	Touch-Line Data SystemLtd	UK	SoccerScout	http://www.touch-line.co.uk
14	Wige Media Ag	Germany	Wige Data	http://www.wige-mic.de

15	Orad	Israel	CyberSet	http://www.orad.co.il/
16	ProZone Holdings Ltd	UK	ProZone	http://www.dalglish.pzfootball.co.uk
17	Symah Vision	France	EPSIS Locator	http://www.epsis.com/
18	Abatec Electronic GmbH	Austria	LPM	http://www.abatec-ag.com
19	Cairos Technologies AG	Germany	Cairos	http://www.cairos.com
20	Trakus Inc	USA	Digital Sports Information	http://www.trakus.com
21	Manapps	France	Stadmaster	http://www.manapps.tm.fr/
22	Sportstec	Australia	TrakPerformance	http://www.sportstecinternational.com
23	NAC Sport	Argentina/Holland	NAC	http://www.nacsport.com
24	Utilius	Germania	Utilius	

6.4.   Advanced Biomechanical Analysis in Situational Sports

6.4.1. Motion Equations and Consequent Trajectories

In order to identify the Motion Equations and the Consequent Trajectories a correct methodological approach has to define the biomechanical system and to identify the forces acting on such system.

Only through this approach will be then possible to get the Motion Equation and the most likely trajectories.

6.4.2. A Unified Theory of situational dual sport with contact

Definition of the dual biomechanical system

1. **The Couple of Athletes Closed System**: the two athletes have fixed and semi stiffed points of contact: the "grips". In this way the two athletes lost their individualities and they merge in an unique system in a steady balance, which moves according to the third principle of Dynamics, while the existing reaction forces will be, in this case, the resultant of the push-pull forces generated by both the athletes.

2. **The Couple of Athletes Open System**: the two athletes have no fixed points of contact and to keep their condition of unsteady balance they will be better approximated to an "upside down pendulum", while thanks to the friction forces they will be able to move, according to the third principle of Dynamics.

Identifying the acting forces

The characterization of the competition environment leads us easily to identify the external forces acting on the athletes:
1. The gravity.
2. The impact or driving forces generated by the opponent.
3. The vincular reactions or ground forces generated by the ground/mattress and transmitted through friction.

Motion

The system "Couple of Athletes" makes "random" motions, generated by the speed variation of the couple or by the change of direction of the resultant of the forces generated by the two athletes in order to create a "convenient situation", that allows the performing of a decisive

skill. The term "random" indicates the condition that statistically no privileged direction of motion exists.

This motion is possible thanks to the friction forces resulting from the contacts between the feet and the ground, according to the third principle of Dynamics.

The general equation describing this dynamic situation is the Newton's Second Law *(F = ma)*.

In generalised force *F* both "friction" and "drive-pull" forces will come out.

They represent pulses acting in very short time intervals.

Therefore the single variation is expressed by Dirac's *"δ"* of the *"u"* pulse of the elementary force.

$$F = ma = -v + u\, \Sigma_j\, (\pm 1)_j\, \delta\, (t - t_j) = F_a + F'$$

m = athlete's mass

a = athlete's acceleration

μ = coefficient of friction

v = athelete's velocity

u = variation of the mechanical momentum (mΔv)

δ = Dirac's delta function

t = time

The motion Langevin equation in Sacripanti's first model is:

"Being the resultant of the "drive-pull forces" of random type, it is not possible to predict the trajectory in a single match, but statistical analysis performed over a significant number of matches, allows the collecting of information on the system behaviour.

Since the change of directions are equiprobable, namely over a great number of matches there is no a privileged direction, then the mean value of F' over a random sequence of directions is null, that is (F') = 0.

If it is experimentally demonstrable that this is true, namely that over a very big number of matches the trajectories don't have any privileged directions (that is they occupy all the available space) then the motion of this system is of a Classic Brownian Passive type" (see fig. 1).
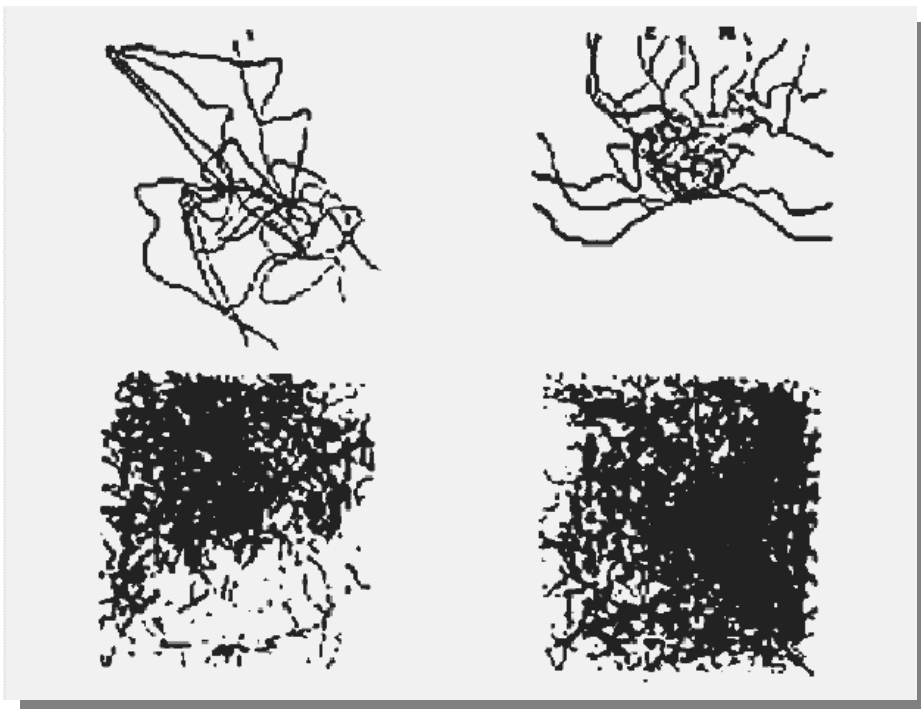
Figure 3 – Dromograms of 1, 1, 7 and 12 Judo matches

6.4.3. Experimental demonstration of the antecedent assumption

According to Smoluchowski[1] the physics of the Brownian motion (or the random evolution of a match), allows us to obtain the basic probability of this Markovian process.

Therefore for Dual Sports we can describe the probability of the basic transition Q and obtain the solution of the conditional probability P that provide us, in the limit of the infinite time, the likelihood of finding the athlete between " x and x + dx, at time t" is given by the following:

Q (k, m) = ½ δ (m ,k −1)+ ½δ (m ,k + 1)

that provides the solution:

$$P(n,m,s) = \frac{s!}{\frac{(v+s)}{2}! \frac{(v-s)}{2}!} (\frac{1}{2})$$

A Unified Theory of Situational Team Sports with contact

Team Sports Athletes do not have fixed points of contacts and in order to keep their unsteady balance conditions they will be better individually approximated to an up-down pendulum model and thanks to friction forces they will be able to move over the pitch,

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[1] **Marian Smoluchowski,** (1872- 1917), Polish scientist, pioneer of statistical physics.

according to the third principle of Dynamics; the team is connected by the strategic interaction.

Identifying the acting forces

The characterization of the competition environment leads us easily to identify the external forces acting on the athletes:

1. The gravity.
2. The vincular reactions or ground forces generated by the ground and transmitted through friction.

The motion

Underlining that the global motion of a team is cyclic for each goal scored, the equations that explain the motion of a single athlete in team sports are much more complex.

Active Brownian motions, rather than the classic passive ones, used to explain dual sports, better approximate these sports, since in this case we must take into consideration the contribution of the oxygen consumption taken from the environment and the reciprocal interaction among the athletes.

The Langevin Equation[2] of motion, proposed in the Sacripanti's second model, takes into consideration both the respiration and the mechanical interactions (clashes + dodges):

$$ma = \gamma_0 - \frac{\overline{V}}{\eta v^2} \, v(r,t) + \frac{m}{t}\left[v^0 e(t) - v_1\right] + \theta k\,(r_{1,2} - d_{1,2})\,N_{1,2} +$$

$$A_{1,2}N_{1,2}e^{\frac{r_{1,2}-d_{1,2}}{B}} \quad \lambda_1 - (1-\lambda_1)\frac{1+\cos_{1,2}}{2} + u\sum_j (\pm 1)\delta\,(t - t_j)$$

that is in a shorter form:

$$F = ma = -\gamma_v v + F_{acc} + \left[\Sigma F_1 + \Sigma F_2\right] + u\sum_j (\pm 1)\delta\,(t - t_j) =$$

$$= -\gamma_v v + F_{acc} + \left[\Sigma F_1 + \Sigma F_2\right] + F''$$

m = athlete's mass
a = athlete's acceleration

---

[2] In statistical physics, a **Langevin equation** is a stochastic differential equation describing Brownian motion in a potential.

γ_0 = *coefficient of friction*

$\overline{V}$ = *athlete's average VO$_2$*

v^2 = *athelete's squared velocity*

η = *Efficiency of internal energy conversion*

v^0 = *desired velocity*

e(t)= desired direction

v_1 = *current velocity*

θ = *deviation directional angle*

k = constant of repulsion among athletes

$r_{1,2}$= *athletes' thoracic dimensions*

$d_{1,2}$= *centres of gravity distances*

$N_{1,2}$= *normalised vector of distance among athletes*

$A_{1,2}$= *constant of interaction among athletes*

B = normalised constant of relative distance

λ_1 =*directional constant*

$cos_{1,2}$= *dodge's angle*

u = variation of the mechanical momentum (mΔv)

δ =*Dirac's delta function*

t = time

Since the change of directions are equiprobable,but with an accumulation point, namely over a great number of matches there is no a privileged direction, then the mean value of F' over a random sequence of directions is null, that is (F') = 0.

If it is experimentally demonstrable that this is true, namely that over a congruent number of matches the trajectories don't have any privileged directions (that is they occupy all the available space) then the motion of this system is of a Brownian Active type (see fig. 2).
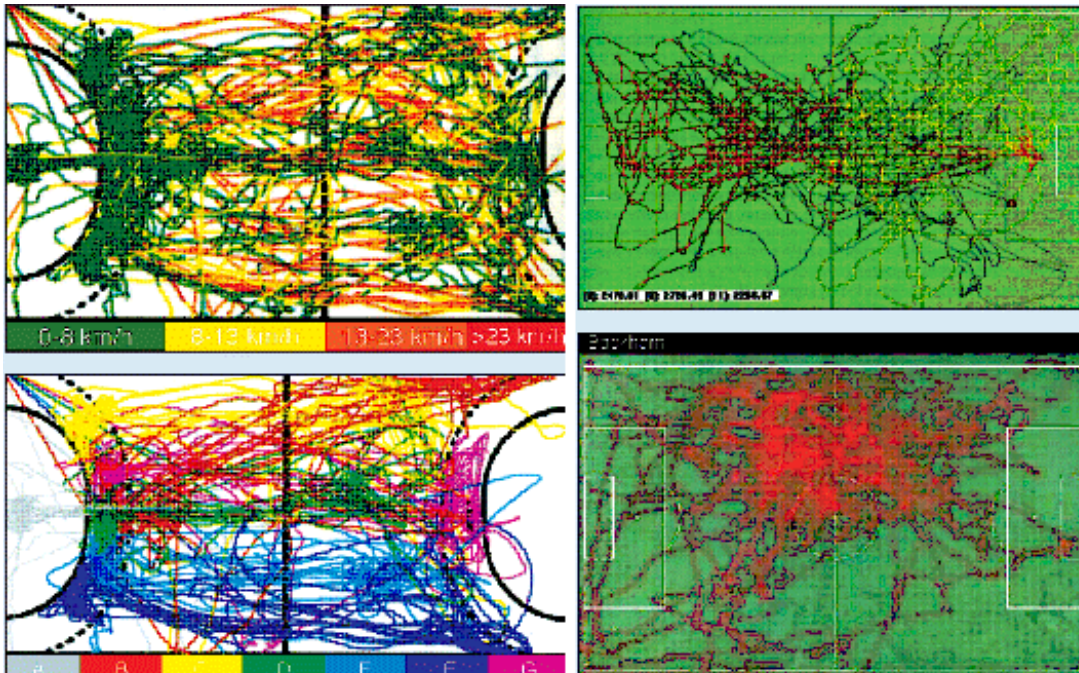
Figure 4 – Dromograms of a really short number of matches (football and basket)

6.4.4. Experimental demonstration of the Brownian nature of the motion

According to Ehrenfest [3], the physics that produces the Brownian mechanism (or the random evolution of the match) allows to obtain the basic likelihood of this Markovian process. Therefore for Team Sports we can describe the probability of the basic transition Q and try to obtain the solution of the conditional probability P that is linked to the mean value, in the limit of the infinite time, of the likelihood of finding the athlete between " x and x + dx, at time t" is given by the following:

$$Q(k, m) = \frac{R^{\alpha} + k}{2R^{\alpha}} \delta(m, k-1) + \frac{R^{\alpha} - k}{2R^{\alpha}} \delta(m, k+1)$$
$$\text{con} -1 \leq \alpha \leq 5$$

P(n[m, s) finds a difficult solution, however its mean value is:

$$\langle m(s) \rangle_{av} = \sum_{m} mP(n[m, s) = 1 - \frac{1}{R^{\alpha}} \langle m(s-1) \rangle_{av}$$

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[3] **Paul Ehrenfest** (1880-1933), Austrian physicist and mathematician. He made major contributions to the field of statistical mechanics and its relations with quantum mechanics, including the theory of phase transition and the Ehrenfest theorem.

Ehrenfest's model, modified by Sacripanti, allows to obtain the basic likelihood of this Markovian process, as a function of attack methods. In team sports we can describe the transition likelihood Q as a function of attack types α, whereas the α parametre varies in the following:

1. immediate counterattack
2. direct play manoeuvres
3. manoeuvred attacks
4. side attacks
5. time wasting strategies.

The solutions of the conditional probability P are linked to the limit of the mean value over time of the likelihood of finding the athlete between x and x + dx at the t time:

$$Q(k,m) = \frac{R^\alpha + k}{2R^\alpha} \delta(m, k-1) + \frac{R^\alpha - k}{2R^\alpha} \delta(m, k+1)$$

$$\text{with } -1 \leq \alpha \leq 5$$

$$\text{with a mean value}$$

$$\langle m(s) \rangle_{av} = \sum_m m P(n[m,s]) = 1 - \frac{1}{R^\alpha} \langle m(s-1) \rangle_{av}$$

These equations confirm that a generalised active Brownian motion is essentially the basic motion of every situational sports with contact.

This assumption, experimentally confirmed by the dromograms of every situational sports, both dual and team sports, allows to use the very large scientific literature regarding the Brownian motion and the stochastic systems, in a way that many results, with the opportune adjustments regarding the sports issues, are already obtained and available, and by simple operational extensions may be assumed as valid even for the investigated issues in sport.

The study of the interaction

In order to study the principles of the biomechanics and the physics that are at the base of the interactions developed within a dual system with contact, we will define those systems as open and closed, according to the different norms that rule them.
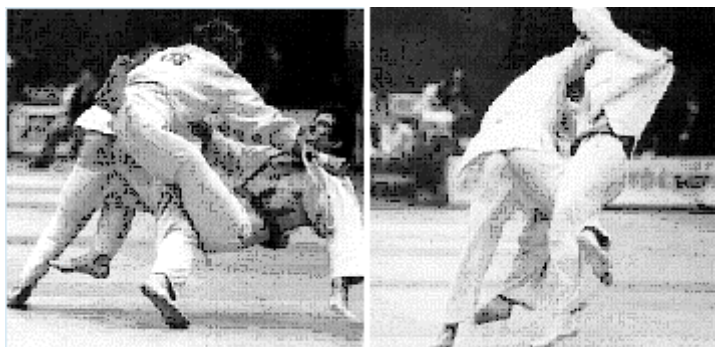
a)   b)

Figure 5 – **Basic physical principles of interactions in a closed couple:**
a) applying a torque – b) applying a lever

c)   d)

Figure 6 – **Physical principles of the open couple system interactions based on the Crash Theory:**
c) short distance application; d) long distance application.

6.4.5. A unified theory of team interaction

The interactions of strategic connection in team sports are based on the throwing (or striking or passing), executed by the upper or lower kinetic chains.

The dynamic interaction with the opposing team is based on the striking (or shooting at goal), executed by the upper or lower kinetic chains.

154

Therefore the throwing, in its two interactive modalities:

   a) strategic – the pass
   b) dynamic – the shoot at goal

   is the basic biomechanical action that primarily represents the interaction in every team sports.

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Chapter 7

A first level CTC Process: the Fitness Conditioning and the Skill Training

7. A 1° level CTC Process – Fitness Conditioning and Skill Training

In team sports many important aspects of the performance of players are referred to the **Individual Fitness Level** (**IFL**) and the degree of a specific **Technical Skill Mastery** (**TSM**) (Dal Monte, 1983; Verchoshanskij 1987, 2001a,b,c,; Bosco,1990,1992, 1997; Reilly et al.; 1993 and 1997; Hughes and Franks, Weineck, 2001; 2004; Carling et al., 2005; Spencer et. Al; 2005; Bonsignore and Ruscello, 2006; Sacripanti, 2007a,b;).

Conditioning and **Training** are the processes undertaken by players and coaches in order to develop at their maximum extent the individual potential of these sides of the performance. Of course these processes are incredibly complex, not already completely known and mastered by the insiders and most of the Sport Science's area of investigation is still devoted to the study and research within this main topics. It is not the aim of this thesis to describe deeply all the issues related to the Conditioning the Individual Fitness Level and Training the specific Technical Skills, but our interest will be aimed at presenting some specific aspect, particularly interesting under the Match Analyst's point of view.

7.1. From physics to physiology: defining Performance Indicators

Team Sports are currently investigated (Weineck, 2001) within different domains (Fig 1). Particularly interesting and actually most used by Coaches and other insiders are the results obtained by the Physics and Exercise Physiology experts.
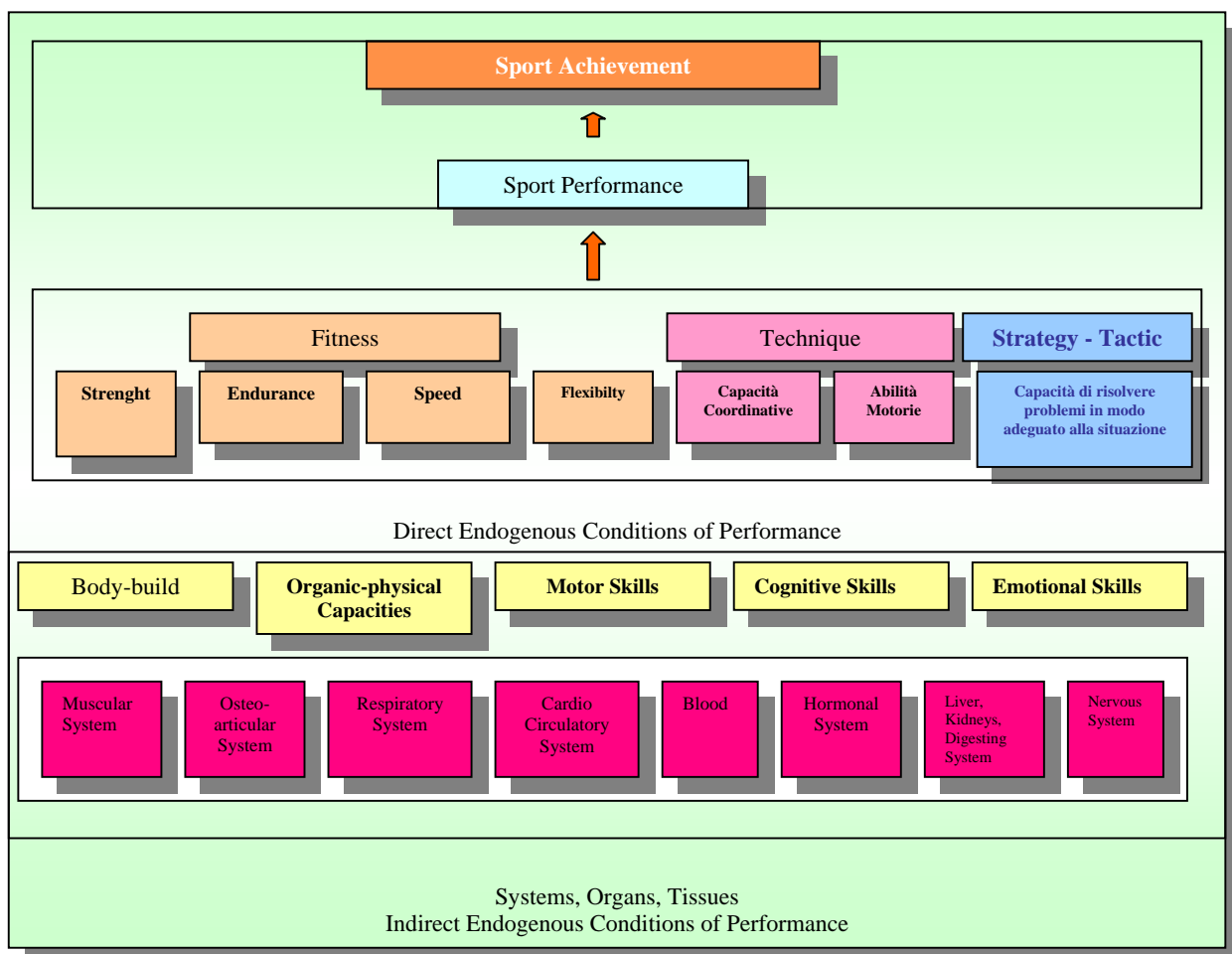
Figure 1 – The complex structure of the Sport Performance

7.2. Physiological demands in outdoor Team Sports (Football, Rugby, Field Hockey)

Competitive match-play in Football, Rugby or Field Hockey, is a non-continuous, high-intensity, intermittent activity that places **heavy demands** on the **aerobic energy system** (Astrand and Rodhal, 2004).

The **anaerobic system** is also very important: brief bursts of high-energy release are separated by periods of lower intensity (Bhanot and Sidhu, 1983; Reilly and Borrie, 1992; Lothian and Farrally, 1995; Nicholas et al., 2000; Murphy et al., 2003; Mendez-Villanueva et al., 2007).

Consequently, a successful player has to be able to perform successive short all-out sprints. The intermittent nature of, and the many changes of direction during, match-play underscores the importance of highly developed sprint capacity and performance in repeated sprints (R.S.A. or Repeated Sprint Ability), as well as of an outstanding slalom sprint performance and interval endurance capacity of elite players (Reilly and Seaton, 1990; Lemmink et al., 2000; Bishop et al., 2001).

Control of the ball while sprinting, turning, passing and scoring goals is only possible if a player possesses excellent technical qualities. A **Straight Dribbling** is defined as running or sprinting in a straight line, whereas **Slalom Dribbling** is defined as running or sprinting with quick changes of direction while maintaining control of the ball (Smith and Chamberlin,1992; Reilly et al., 1997).

7.2.1. A Case Study: Fitness Performance Indicators in Field Hockey

Introduction

The main aim of this study is to determine whether a relationship exists between some performance characteristics and level of performance in talented women field hockey players. A comparison is made between a group of Elite players (Senior o Under 21 Italian National Team) and a group of sub-elite players, involved in the first division of the Italian League (serie A), in terms of anthropometrics and physiological characteristics.

In order to do that, we performed a series of fitness tests with the aim of investigating mostly the sprint and power abilities of these players and to compare the gathered results with the ones obtained by different researchers[1] currently committed on this line of research, namely the **Repeated Sprint Ability**.

High-intensity sprints of short duration, interspersed with short recoveries, are common during most team sports (Ruscello and Iaccarino, 1995; Bishop et Al., 2001, 2002). Therefore, the ability to recover and to reproduce a high power output in subsequent sprints is an important fitness requirement of team-sport athletes and has been termed **Repeated Sprint Ability** (RSA). While little is known about what limits RSA, some of the more important physiological determinants would appear to be aerobic fitness, muscle buffer capacity and the ability to rapidly resynthesise phosphocreatine (PCr).

The extent of the decrease in pH during muscular activity is dependent upon both the production of hydrogen ions (H+) and on muscle buffer capacity (βm). It appears that high-intensity interval training (80-90% VO2max) interspersed with rest periods that are shorter than the work periods is required to increase βm. Furthermore, some research also suggests that training too intensely may actually decrease βm. Changes in βm are not as great following intermittent sprint training and this may be because changes in H+ are quite small during this type of exercise. As oxidation is essential for PCr resynthesis, according to Spencer and Bishop studies, individuals with an elevated aerobic fitness should be better able to resynthesise PCr following exercise. Indeed, their research supports the hypothesis that endurance training enhances PCr resynthesis following low-intensity exercise.

They have shown that high-intensity interval training can significantly improve brief (60-s) PCr resynthesis and RSA. In contrast, intermittent sprint training has not been reported to increase the rate of PCr resynthesis. These results can probably be attributed to the absence of changes in muscle oxidative capacity with this type of training. Thus, rather than game specific training, training designed to improve muscle oxidative capacity may be required to improve this important physiological

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[1] Spencer, M., Bishop, D. et al. (2004). Journal of Sports Sciences. 22; 843-850.
Bishop, D., Edge, J.E. et al. (2006). European Journal of Applied Physiology. 96; 225-234.
Bishop, D., Edge, J.E. et al. (2006). Journal of Applied Physiology. 101;918-925.

quality in team-sport athletes. They have shown that it is possible for athletes to reach their VO2max during a RSA test. This suggests that increasing VO2max may allow for a greater aerobic contribution during the latter sprints, potentially improving performance. While further research is required, game-specific training (using small-sided games) and repeated-sprint training have not been shown to be more effective than interval training for improving aerobic fitness in team-sport athletes. This is not surprising as increases in aerobic fitness are influenced more by the total work performed than the type of exercise.

Methods

Participants

Twelve Elite players (N=12) took part to this research with Eleven Sub-Elite Players (N=11).

All players were considered to be talented, since they were already selected in a national team, both Senior or Junior (Elite Players) or playing in the Italian National League, (Sub-Elite players) at first division level (Serie A).

The relevant bio data of the sample are reported in the table below.

	Elite Players (N=12)	Sub-Elite Players (N=11)
Age (Mean + SD)	25.50 ± 4.44	19.73 ± 2.69
Height - (Mean + SD); cm.	165.09 ± 3.42	166.27 ± 6.90
Weight (Mean + SD; Kg.	58.82 ± 5.86	58.82 ± 6.81
Body Mass Index (B.M.I.)	21.60 ± 2.15	21.24 ± 0.88
Percentage of Body Fat	16.94 ± 2.91	17.11 ± 1.73
Number of training hours per week	6.7 ± 1.2	7.0 ± 1.8

Table 1 – Sample Bio data

A significant difference between the sample groups is represented by the average age (25.50 vs. 19.73; t (22) = 3.33, p<.05), whereas the other considered averages anthropometrics data do not significantly differ.

Procedure

All players were informed about the procedures of the study before providing their verbal consent to participate. The governing body of the clubs and the Italian Hockey Federation also gave their permission for the study to proceed. The

procedures were in accordance with the ethical standards of the University of Rome Tor Vergata, Faculty of Medicine and Surgery.

The players completed all tests on November 2007 in Pisa, at end of the first part of the competitive field hockey season, and before the beginning of the indoor season. They were told that the results would be used anonymously.

Anthropometric characteristics

Four variables were measured for each player: height, (cm.), body mass (Kg.), Body Mass Index (BMI) and the Percentage of Body Fat. The latter was estimated by means of Plicometry, according to the Jackson and Pollock formulas[2].

Physiological characteristics

All players performed six field tests to determine six physiological characteristics. These characteristics included:

1) **peak sprint performance** (with and off the ball over 30 metres);

2) **repeated sprint performance** (Repeated Sprint Ability or R.S.A.): 6 x 30 metres sprints, with 30" passive recovering each run;

3) repeated shuttle run test (Leger Test) in order to assess the **endurance capacity** and, indirectly, the VO_2 max.

4) Jumping Tests according to the Bosco's protocol[3], in order to evaluate the **muscle power** and the **muscle elasticity** (SJ-CMJ) and the **specific endurance to strength** (15" CMJ Bosco Test).

Material and Methods

All the running tests were performed in Pisa, over a synthetic hockey pitch, water filled, in the period of November 20th-26th , 2007. The weather was fine all the time with an average temperature of 14-21°. The players performed the running tests wearing the usual match shoes.

All the jumping tests were performed in a gym close to the pitch, with a concrete, smooth pavement used as an indoor tennis court. The players performed the jumping tests wearing "track and field" shoes.

Peak sprint performance (with and off the ball) and the **repeated sprint performance** were measured by means of electronic chronograph (Globus – Ergo

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[2] Jackson A. S.; M. J. Pollock; (1985) *"Practical Assessment of Body Composition"* in Physician and Sports Medicine Vol 13(5): 76-90

[3] Bosco C., (1992); *"La valutazione della Forza con il Test di Bosco"*; Società Stampa Sportiva; Roma

Tester; Italy) activated by photoelectric cells (Globus – Ergo Timer; Italy). The **Leger Shuttle Run Test** was administered and recorded through the Ergo Tester by Globus.

All the **Bosco's Jumping Tests protocols** were administered by mean of a conductive electronic platform (Pedana di Bosco) linked to the Ergo Tester by Globus.

The peak sprint performance test (**p.s.p.**) was designed in order to measure:

1) the maximum sprint ability of each player,

2) their ability in a technical skill like the "forehand stick fast dribbling"

3) the difference between sprinting with and off the ball, calculating the decrement percentage of among the different modalities.

The test distance selected was 30 metres, to be run at maximum velocity, starting at a free choice of the player. We recorded the two different modalities of sprinting over this distance, asking the player to perform twice each modality. We then choose the mean value of the two.

Resting time between each repetition was 3-5'. A passive recovery was asked (stretching) to all the players.

The repeated sprint performance test (**r.s.p.**) was designed in order to measure the Repeated Sprint Ability (**R.S.A.**) of each player, slightly modifying the Fitzsimons Protocol (Bangsbo et al.,1991, 1996; Bishop et al., 2001, 2002). The test was about to sprint at maximum velocity over 30 metres for 6 times, with a recovery period of exactly 30" per repetition. The players were told that the goal of the test was to achieve the best performance in each repetition, starting from the very first sprint.

We analyze this test applying this protocol:

1) we computed the total time over the 6 repetitions;

2) we estimated the ideal total time, multiplying the best result (the lowest recorded time) per 6;

3) we   calculated   the   %   of   decrement   applying   this   formula   =

$$\left(\frac{TotalTime}{IdealTime} \ \mathbf{x\ 100} \right) \mathbf{-\ 100.}$$

(see the example below)

total time	33.00
ideal time	lowest x 6
	= 5.27 x 6
	= 31.62
% Decrement	= (total/ideal x 100) - 100
	= (33.00/31.62 x 100) - 100
	= 104.4 - 100
	= 4.4%

Fig. 2 – Calculating the % decrement over a RSA test.

The repeated shuttle run test (Leger Multistage Run Test) was administered in order to assess the **endurance capacity** and, indirectly, the VO_2 max, through the standard conversion table provided by professor Leger et al.

As usual the test was performed over a distance of 20 metres, directly on the hockey pitch, to be repeated as a shuttle, back and forth, according to a imposed rhythm administered automatically by the Ergo Tester device. Each minute or so, the imposed rhythm is increased, and the player must accelerate in order to cope with this changed situation, until she found herself unable to stay with the imposed pace. At this time the test is over for her and the total time performed is recorded. Conversion table provided an estimation of the VO_2max referred to the reached stage.

The **Bosco's Jumping Tests protocols** were performed in order to assess the **muscle power** (Squat Jump – SJ; Countermovement Jump - CMJ), the **muscle elasticity** and the specific muscle endurance, through a **15" Repeated Jumping Test**. Each player performed three Squat Jumps and three Countermovement Jumps, according to the Bosco's protocol. A recovery time of 2' was administered at each repetition. The mean value of the three jumps was considered for the subsequent elaborations.

In order to define the **muscle elasticity**, the average differences between the mean value of the CMJ Jumps and the SJ Jumps were calculated. Synthetic elastic indexes were also computed, according to this formula:

$$\left(\frac{Mean\_CMJ - Mean\_SJ}{Mean\_SJ} \right) \times 100$$

A conversion table provided by professor Bosco et al. can be used in order to assess the Muscle Elasticity (see table below)

Reference values		
	Male	**Female**
Bad	**<10%**	**<10%**
Enough	**10-15%**	**10-15%**
Good	**16-19%**	**16-19%**
Very good	**20-24%**	**20-24%**
Excellent	**>24%**	**>24%**

Table 2 – Bosco's Index conversion table. Muscle Elasticity

The **15" Repeated Jumping Test** was performed by each player just once. We considered the average height, the average power, the number of jumps performed in 15", and we computed the **Bosco Index**, which is the ratio between the average height reached during the 15" test and the best result obtained in a single CMJ, according to this formula:

$$\left(\frac{15"\,Jumping\_Average\_Height}{Single\_CMJ\_best\_result} \right) \times 100$$

A conversion table provided by professor Bosco et al. can be used in order to evaluate the specific strength endurance needed by team sports players (see table below)

Reference values		
	Male	**Female**
Bad	< ,80	< 80
Enough	80-85	80-85
Good	86-90	86-90
Very good	91-95	91-95
Excellent	> 95	> 95

Table 3 – Bosco's Index conversion table. Specific Strength Endurance.

Data analysis

Mean scores and **standard deviations** were calculated for each variable for the different sub-groups according to the two categories of performance characteristics (anthropometrics and physiological).

Independent *t*-**Tests** were performed in order to find significant differences between the investigated groups (Elite and Sub-Elite Players) and provide useful Performance Indicators, referring to the different categories of performance characteristics (anthropometrics and physiological).

Correlations Analysis were performed in order to find correlations among the investigated variables.

A **Classification Tree** procedure was applied in order to find possible predictor of performance.

An *alpha* **of 0.05** was adopted for all tests of significance.

All the data were processed using the software Microsoft Excel 2000 and the SPSS 13.0 windows package.

Results

Table 3) presents the means and the standard deviations of the investigated performance characteristics:

Performance characteristics	Elite Players (N=12)	Sub-Elite Players (N=11)
Sprint Peak Performance Test:		
30 metres, off the ball (s)	4.99 ± 0.18	5.21 ± 0.20
Sprint Peak Performance Test:		
30 metres, with the ball (s)	5.39 ± 0.20	5.65 ± 0.19
R.S.A. Test – Average Speed		
over 6 sprints (s)	5.21 ± 0.22	5.46 ± 0.24
R.S.A. Test – Average % Speed		
Decrement	4.29%	4.94%
Leger Test		
VO$_2$ max (ml O$_2$/kg/min)	50.17 ± 2.09	48.35 ± 2.73
Legs Muscles Strength:		
SJ (cm.)	28.55± 3.27	26.45 ± 2.69
Legs Muscles Strength:		
CMJ (cm.)	33.33 ± 4.03	29.41 ± 3.20
Legs Muscles		
Elasticity (cm.)	4.35 ± 3.36	3.87 ± 1.97
Legs Muscles		
Elasticity Index (%)	13% ± 9%	12% ± 6%
15" Jumping Test		
Height (cm.)	26.55 ± 3.77	26.17 ± 2.25
15" Jumping Test		
Power (Watt)	21.45 ± 2.78	21.39 ± 1.55
15" Bosco's Index	81.55% ± 6.4%	89% ± 4.2

Table 3 – Performance Characteristics

In order to define the possible significant differences between the two investigated sub-groups (Elite and Sub Elite players), an Independent t-Test was performed for every Performance Characteristics reported in Table 3).

There were no significant differences between the groups but just in one case, **regarding the Repeated Sprint Ability**, tested through the repetition of 6 times 30 metres at maximum speed, with a recovery time of exactly 30" at each sprint.

The difference of the overall average time performed by the groups **is significant** (5.21 vs 5.46; t (20) = 2.53, p<.05) and quite interesting under a coaching point of view, since this issue seems to be a good predictor of the level achieved by the players, and it is the only fitness characteristic that differs significatively between each group.

It is also to underline the temporal pattern observed in this test, (table 4) regarding the different speeds performed by the players at each repetition, where most of the difference is concentrated in the last sprints, where the Elite players were able to keep their velocity higher and closer to the first repetitions than the Sub-Elite group.

	Elite Players	Sub Elite Players
Rep.1	5,15	5,31
Rep.2	5,16	5,40
Rep.3	5,23	5,47
Rep.4	5,24	5,50
Rep.5	5,23	5,56
Rep.6	5,22	5,50

Table 4 – Temporal Pattern in R.S.A.
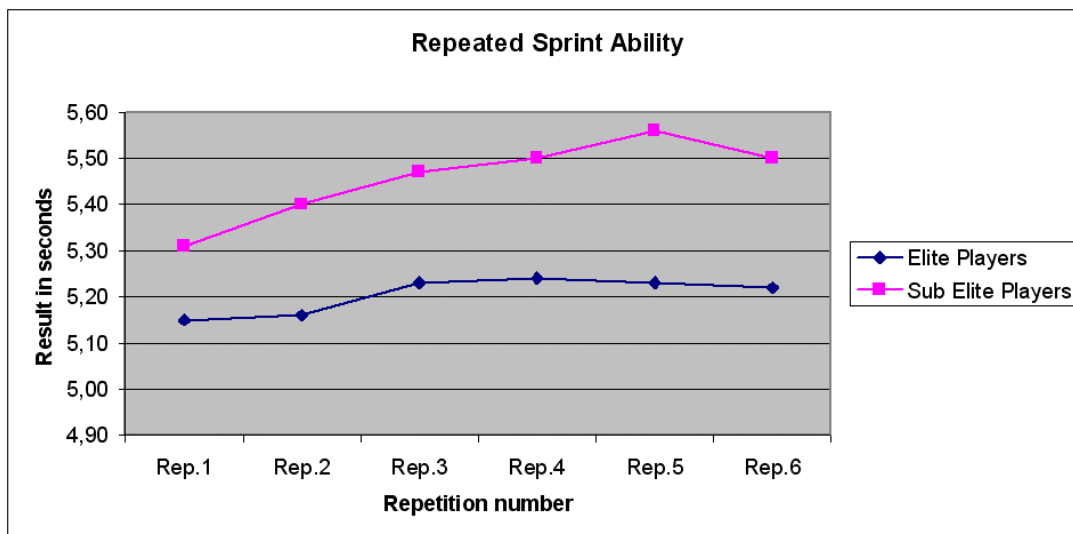
Fig. 3 – Observed trend in Repeated Sprint Ability over 30 metres, performed by Elite and Sub Elite Hockey Players, women.

The shape of the curves reported above (fig. 2) confirmed the substantial difference existing in this particular fitness characteristic between Elite and Sub Elite players (see also Table 5 and 6) , and allow us to say that testing the R.S.A. could be seen as a useful Performance Indicator, able to differentiate, under the physiological point of view, the different levels of qualification.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Repeated Sprint 1	Elite	12	5,15	,26	,08
	Sub Elite	10	5,31	,16	,05
Repeated Sprint 2	Elite	12	5,17	,21	,06
	Sub Elite	10	5,41	,27	,09
Repeated Sprint 3	Elite	12	5,23	,24	,07
	Sub Elite	10	5,47	,28	,09
Repeated Sprint 4	Elite	12	5,24	,25	,07
	Sub Elite	10	5,50	,27	,09
Repeated Sprint 5	Elite	12	5,23	,21	,06
	Sub Elite	10	5,57	,31	,10
Repeated Sprint 6	Elite	12	5,23	,20	,06
	Sub Elite	10	5,50	,30	,10

Table 5 – All the sprints values are reported. The consistency of the performance of the Elite players is confirmed also by the Standard Deviation trend, which keeps steady values throughout the testing.

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Repeated Sprint 1	Equal variances assumed	,89	,36	-1,72	20,00	,10	-,16	,09	-,36	,03
	Equal variances not assumed			-1,80	18,31	,09	-,16	,09	-,35	,03
Repeated Sprint 2	Equal variances assumed	,98	,33	-2,34	20,00	,03	-,24	,10	-,45	-,03
	Equal variances not assumed			-2,28	16,83	,04	-,24	,11	-,46	-,02
Repeated Sprint 3	Equal variances assumed	,60	,45	-2,19	20,00	,04	-,24	,11	-,47	-,01
	Equal variances not assumed			-2,16	17,88	,05	-,24	,11	-,48	-,01
Repeated Sprint 4	Equal variances assumed	,08	,78	-2,33	20,00	,03	-,26	,11	-,50	-,03
	Equal variances not assumed			-2,32	18,67	,03	-,26	,11	-,50	-,02
Repeated Sprint 5	Equal variances assumed	,13	,73	-3,04	20,00	,01	-,34	,11	-,57	-,11
	Equal variances not assumed			-2,93	15,34	,01	-,34	,12	-,58	-,09
Repeated Sprint 6	Equal variances assumed	,36	,55	-2,53	20,00	,02	-,27	,11	-,50	-,05
	Equal variances not assumed			-2,43	15,20	,03	-,27	,11	-,51	-,03

Table 6 – The *t* -Test values are reported for each sprint repetition performed by Elite and Sub–Elite players. After the first sprints, (*t* (20) = 1.72 p<0.05, not significant) the groups started differentiating their behaviors, in a significant way (2.19 ≤ *t* (20) ≥ 3.04; p<0.05) .

In order to find possible correlations between the R.S.A. and the Aerobic Fitness, as reported by several authors (Bishop, 2005, Spencer, 2008), we correlated the average results obtained in testing repeated sprints over 30 metres and the results obtained from the Leger Test, investigating the Aerobic Power.

No significant correlations were found about this matter, as reported in table 7), between the values of VO$_2$max, obtained by the Leger conversion table, and the Mean Values of the repeated sprints.

Correlations

		Mean Value Rep. Sprint	VO2max - ml/kg/min
Mean Value Rep. Sprint	Pearson Correlation	1,00	-,33
	Sig. (2-tailed)		,14
	N	22,00	22,00
VO2max - ml/kg/min	Pearson Correlation	-,33	1,00
	Sig. (2-tailed)	,14	
	N	22,00	24,00

Table 7 – Correlations between VO$_2$ max and R.S.A.

To double check this finding we correlated the values of the Leger Tests, expressed in total amount of seconds performed and the average results obtained in testing repeated sprints over 30 metres and again we found no significant correlations, as shown in table. 8) and Fig.

Correlations

		Mean Value Rep. Sprint	Leger - Seconds
Mean Value Rep. Sprint	Pearson Correlation	1	-,331
	Sig. (2-tailed)		,132
	N	22	22
Leger - Seconds	Pearson Correlation	-,331	1
	Sig. (2-tailed)	,132	
	N	22	24

Table 8 – Correlations between the Total Amount of Seconds Performed during the Leger Test and R.S.A. values.
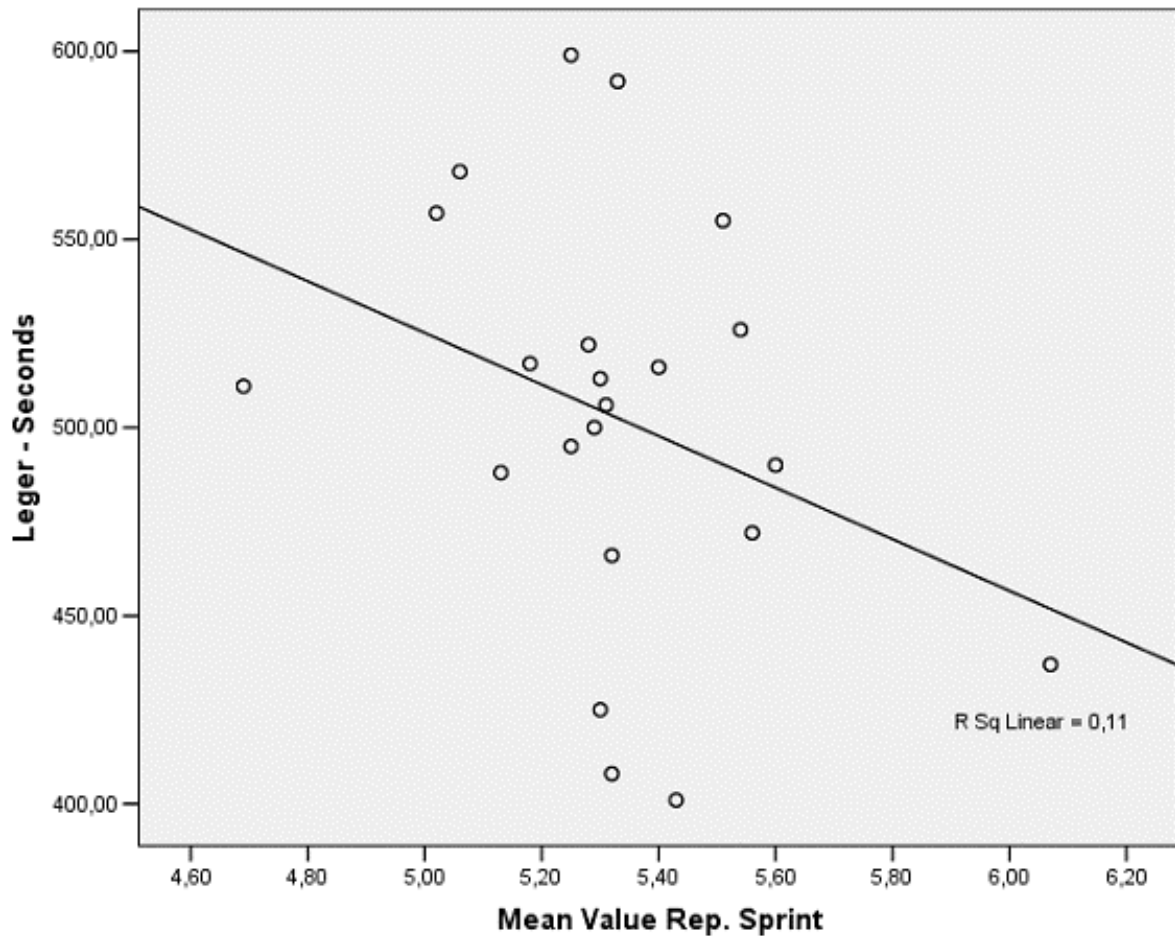
Figure 4 – Graphic representation of the correlations between the Total Amount of Seconds Performed during the Leger Test and R.S.A. Mean Values.

We also applied a **Classification Tree** procedures in order to find possible **predictors of performance** (see figure 4)

Group

Node 0

Category	%	n
■ Elite	54,2	13
■ Sub Elite	45,8	11
Total	100,0	24

■ Elite
■ Sub Elite

Sprint Test 30 metres ball
Adj. P-value=0,040, Chi-square=9,
455, df=1

<= 5,59

> 5,59; <missing>

Node 1

Category	%	n
■ Elite	72,2	13
■ Sub Elite	27,8	5
Total	75,0	18

Node 2

Category	%	n
■ Elite	0,0	0
■ Sub Elite	100,0	6
Total	25,0	6

Age
Adj. P-value=0,020, Chi-square=8,
654, df=1

<= 21,00

> 21,00

Node 3

Category	%	n
■ Elite	37,5	3
■ Sub Elite	62,5	5
Total	33,3	8

Node 4

Category	%	n
■ Elite	100,0	10
■ Sub Elite	0,0	0
Total	41,7	10

Figure 5 – Classification Tree – The tree model

According to the **Tree Model** provided in Figure 4) **a good predictor of performance,** namely able to actually differentiate the belongings of the players to the differently qualified groups, is the time performed over 30 metres leading a ball. (adjusted $P < 0,040$, Chi-Square 9,455, df=1). This aspect implies not only the physiological domain (the speed) but takes into consideration a different domain, which is the individual technical skill in solving this kind of problem.

In this procedure we used the growing method called CHAID (Chi-squared Automatic Interaction Detection).

At each step, CHAID chose the independent (predictor) variable that had the strongest interaction with the dependent variable. Categories of each predictor were merged if they were not significantly different with respect to the dependent variable.
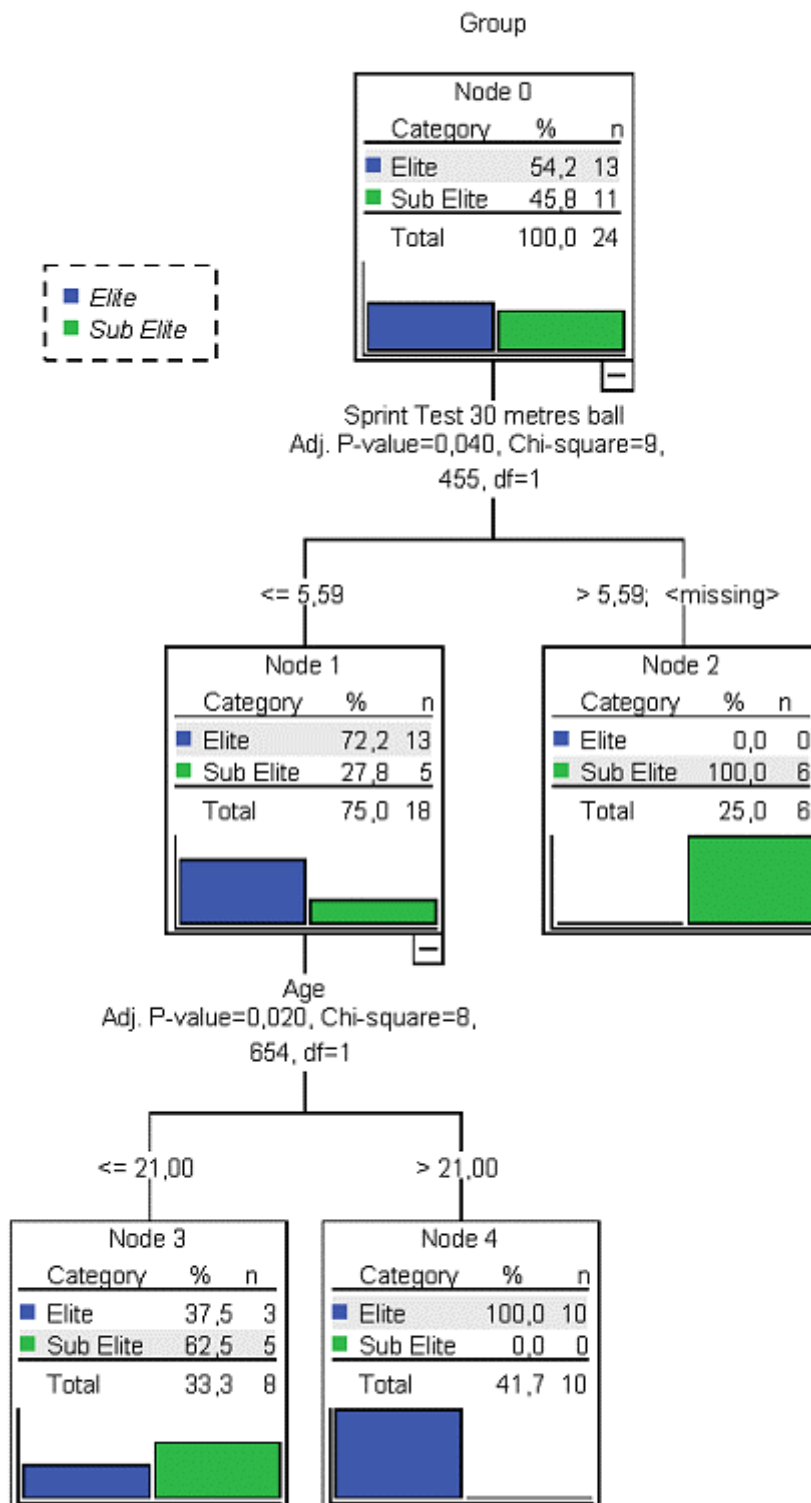
Conclusion

In order to define possible Performance Indicators, able to eventually differentiate Elite from Sub-Elite players, we analyzed a group of International Hockey Players, belonging to the Italian National Senior Team, in preparation to the Olympic Qualifier 2008, field-testing their physical qualities under different point of views, and comparing their results with the ones obtained contemporarily field-testing a group of Sub-elite players.

The results showed that the only fitness performance indicator able to orientate the focus of the coaches in selecting players or, for match analysts, to identify high-level players during a game, is the Repeated Sprint Ability. The differences found with this study confirmed several suggestions regarding this issue, provided by several authors (Spencer and Bishop, 2004, 2007; Colli R., 2005, etc.).

7.2.2. A Case Study: A 3D kinematics analysis of the field hockey pushing while in a stationary position.

In order to investigate a field hockey basic skill, "the push", particularly relevant in modern hockey (Mignardi and Ruscello, 1993, 2006), since the ever increasing use of the synthetic pitches at the international level all over the world (Whitacker, 19992; Wein, 1999), we decided to study this technique under a "pure" biomechanical point of view (Donskoj et al., 1983; Hay, 1985; Stuelcken, 2003; Sacripanti, 2004), determining the kinematics through a stereophotogrammetric procedure of analysis, performed thanks to a protocol agreement signed by the University of Sport Science of Rome (IUSM), now called University of Rome "Foro Italico", and the University of Rome Tor Vergata, Faculty of Medicine, Sport Science Department.

The procedures of acquisition of the relevant data were performed at the Department of Human Movement and Sport Sciences of IUSM, directed by Prof. Aurelio CAPPOZZO.

The research was carried out by Camomilla Valentina[4], Cherubini Domenico[5], Sacripanti Attilio[6][7] and Ruscello Bruno[7].

The poster of this research was presented at the "Team Sport Conference", organised by the University of Verona, at Verona-Ghirada on 7-8th June 2008. The abstract published by the *Coaching and Sport Science Journal*[8].

Introduction

Field Hockey is a very popular outdoor stick and ball team sport. Its technical performance is heavily affected by the proper use of its distinguishing tool, the stick. In order to control, lead, and propel the ball, various techniques have been developed and trained by coaches and players, with the aim to improve speed, power, and precision in all the aspects of the game. Pushing the ball is considered one of the real basic skills of this sport, particularly with the ever-increasing use of artificial turf.

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[4] Dept. of Human Movement and Sport Sciences, IUSM Roma, ITALY.
[5] Dept. of Human Movement and Sport Sciences, IUSM Roma, ITALY.
[6] Sport Sciences Dep., Faculty of Medicine, Tor Vergata University, Roma, ITALY
[7] ENEA - Italian National Agency for New Technologies, Energy and the Environment
[8] "A 3D kinematics analysis of the field hockey pushing while in a stationary position"; di Camomilla V., Cherubini D., Sacripanti A. e Ruscello B.; Coaching and Sport Science Journal; Volume 3 – Numero 2, Maggio-Agosto 2008; pp. 24

In this case study, the 3D kinematics of the push technique used in stationary ball situations was analysed to detect crucial features to be considered in training to improve precision, while keeping the operating speed consistent with the competitive needs of the game.

The push

During the stroke, the body weight transfers from the right to the left foot without rising; the hands are placed apart on the stick and, as the right arm pushes forward, the left hand pulls the top of the handle backward causing the head of the stick to accelerate. The right arm controls the pass, keeping in line with the ball trajectory.
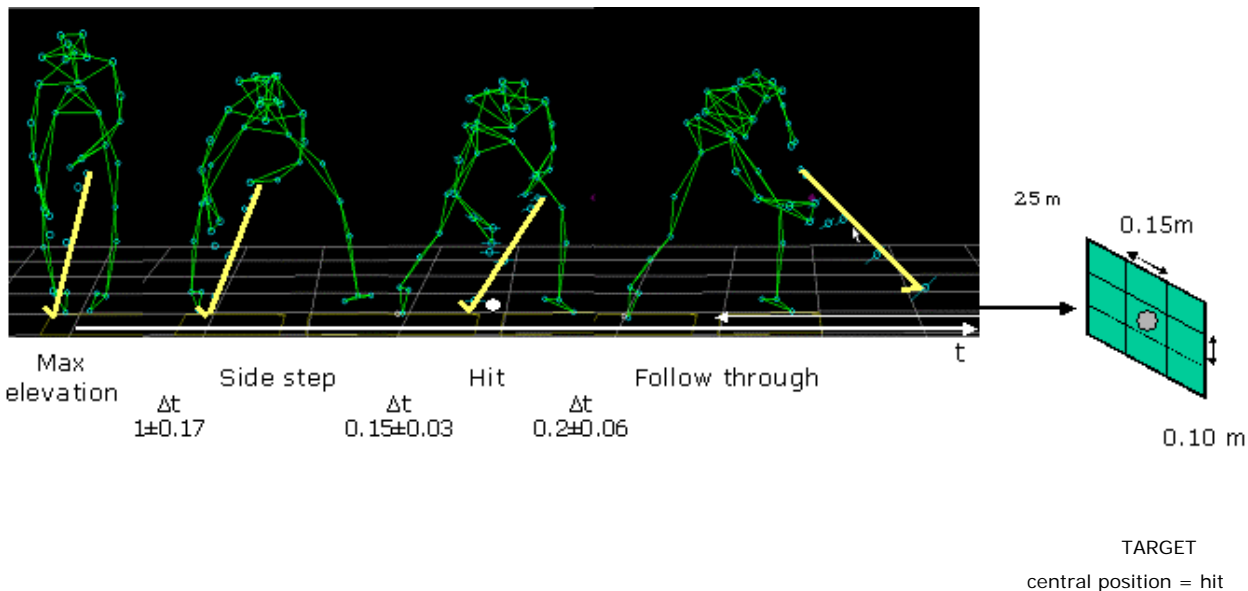

Figure 6 – Starting position and marker set: full body conventional PlugIn Gait on the body, 4 markers on the stick, 3 on the target.

Materials and Methods

An elite male hockey player (international level) performed 50 pushes, with the aim of hitting a target (0.15 x 0.10 m) placed at 2.5 m from him. Data were acquired with a 9 camera VICON 612® photogrammetric system.

The value at the impact with the ball and the maximal value of knee flexion-extension, hip angular kinematics, pelvis and shoulder angular velocity, pelvis-shoulder angle and stick velocity (showed in Figure 3) were considered to predict a dichotomous hit variable using a logistic regression.


Results

The abduction and flexion angles of the left hip proved to be the most significant predictors of the hit, followed by the angular velocity of the shoulder and, consequently, by the linear velocity of the head of the stick. The important role played by the correct positioning of the lower limbs and hips in obtaining precision using this technique confirmed what is stressed during the training sessions from a traditional coaching point of view as result of experience, and qualitative biomechanical analysis performed in good coaching practice.

		fe_K	fe_H^*	aa_H^*	ie_H	v_{ST}^*	α_{PV-SH}	ω_{PV}	ω_{SH}^*
		deg	deg	deg	deg	m/s	deg	rad/s	rad/s
max	mean	59,7	47,3	38,0	22,0	13,0	24,5	7,0	8,2
	st dev	4,2	5,5	10,7	12,0	2,2	7,8	1,5	1,3
impact	mean	53,4	38,3	36,5	19,1	5,2	21,2	4,5	5,8
	st dev	8,4	6,1	6,6	5,9	1,9	3,3	1,9	2,2
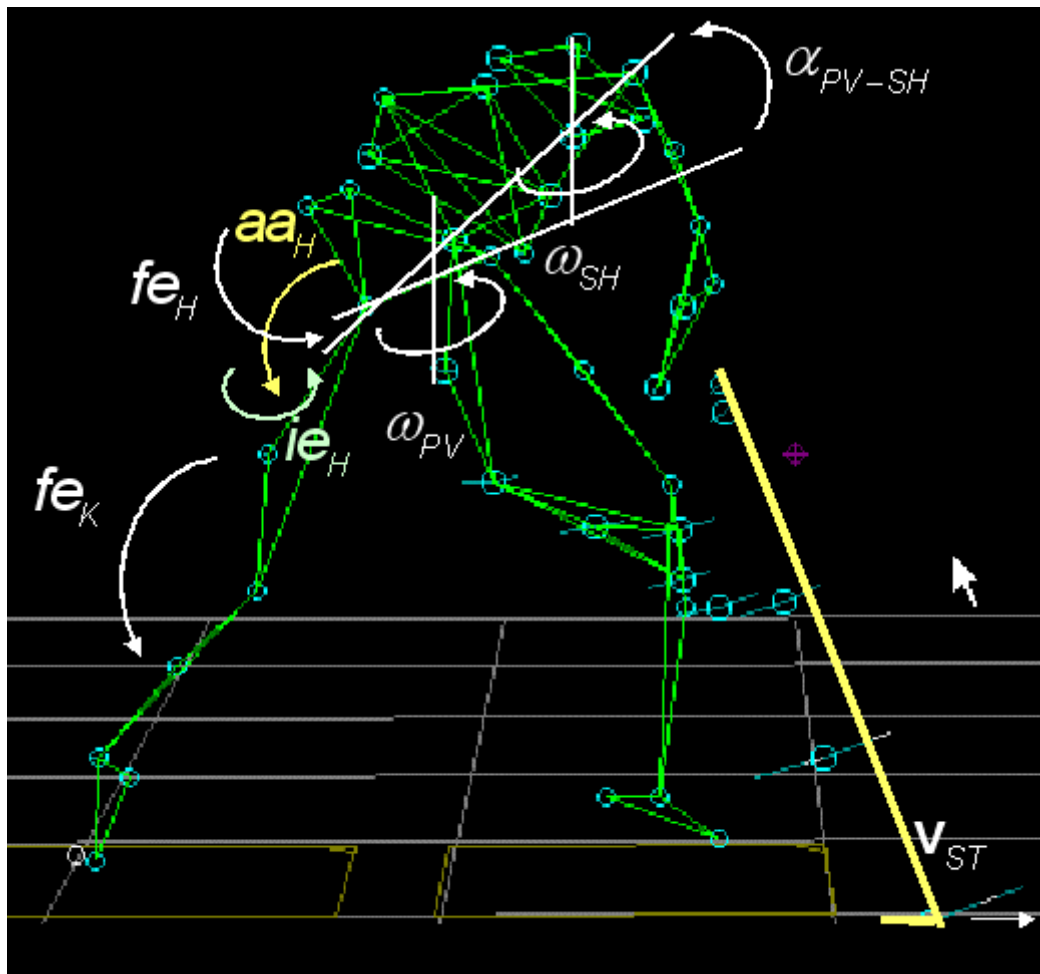
Significant predictors of the hit variable are indicated with a *

Discussion and Conclusions

This case study evidenced the potential of a 3D kinematics analysis in providing a sound theoretical background to design a training method aimed at improving this crucial technique. Further studies, including more elite subjects and a non-elite population, are required to generalise these results and to confirm or refute common coaching points of view on this technique.

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Chapter 8

A second level CTC Process: the Local Strategies and the Competition Invariants

In this chapter we will go through those ***special situations*** that are considered important aspects of the whole performance in situation sports. We are now considering the **local strategies** performed or applied during a match, in order to organise all the available resources towards specific goals to be achieved, both in dual or in team sports.

8.1   Local Strategies: definition

Situation sports (team sports, combat sports, etc.) are based on the athletes' "reading the game/match" ability, while performing in a competitive contest (Weineck, 2001). The ***Local Strategies*** are fundamental parts of the specific training process in these athletic disciplines and many scholars (Reilly et al., 1993, 1997; Kormelink et al., 1999; Jonsson et al.; 2001; Laird et al., 2003; Carling et al., 2005; Ciuffarella et. al., 2008) consider them as the real "core" of the whole performance capacity of a player or athlete.

A short definition could be as follow (Sacripanti, 2007b):

"The local strategies are the study of the situations occurring in a delimited part of the pitch or field and they are not involving all the team members at the same time. They are particularly referred to:

1. attacking strategies;

2. defending strategies;

3. strategies aimed at keeping the advantage;

4. strategies aimed at recovering from the disadvantage."

The **Local Strategies** are implemented over an underlying structure: the **Tactic Capacity** of a player/athlete who can cope with the ongoing situation thanks to his/her capacity of data processing, according to the following scheme (Manno, 1982):
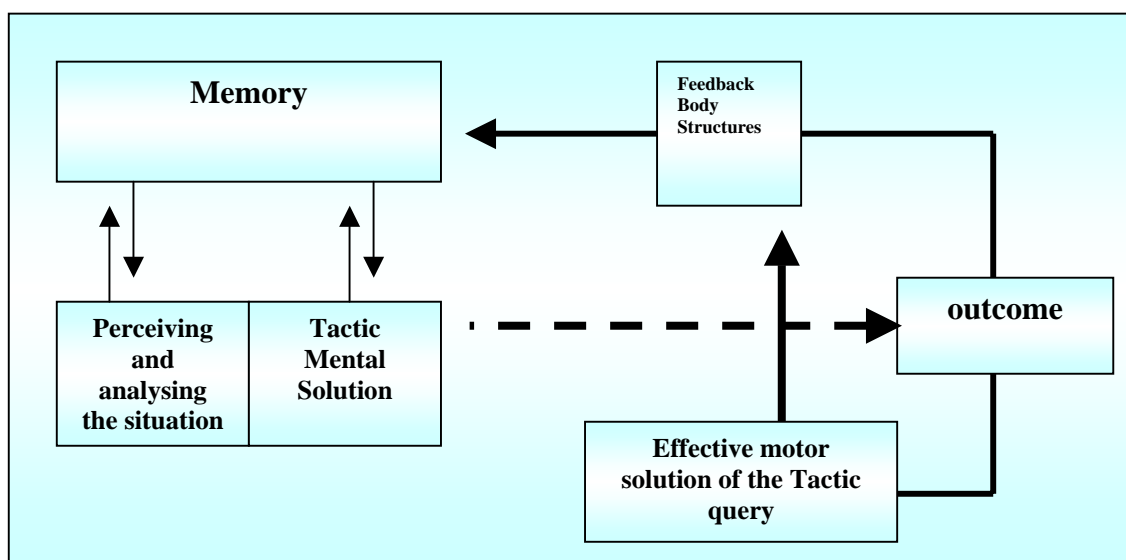
Figure 1 – Tactic Action and interactions in its phases – (Mahlo, F.; "L'Acte Tactique en jeu"; 1968)

The Local Strategies may be analysed through the appropriate Match Analysis procedures, by means of the Database that those systems allow to develop. Therefore it is possible to point out the situation main points involving the local strategies in order to train them, according to a specific plan of practises or drills.

In Figure 2) and 3) some examples of Local Strategies, based on the data collected by Match Analysis procedures, are provided.
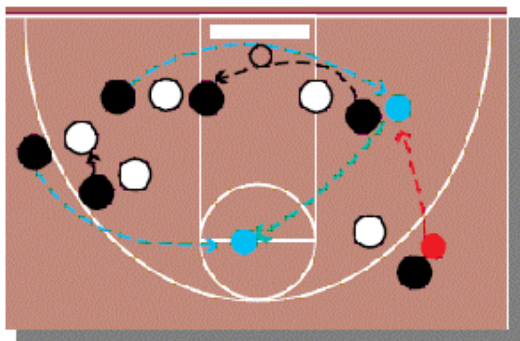
Figure 2   Basketball – Local Strategies
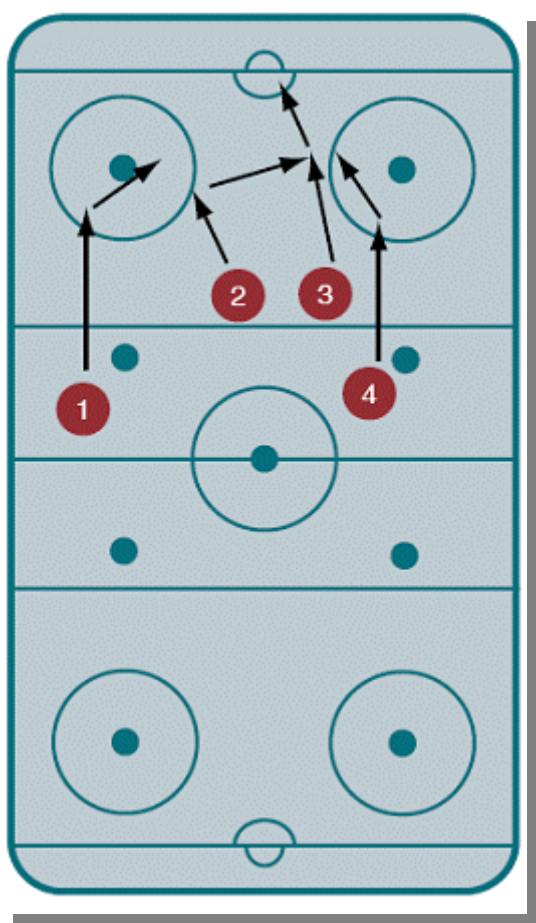
Figure 3 Ice Hockey – Local Strategies

We highlight that analysing a Match through the appropriate methods, may provide crucial information not only about one's own team but, interestingly, also about the opponent's one, therefore allowing to point out the strongest and the weakest sides of the teams.

8.2. Competition Invariants: definition

In Situation Sports many patterns are similarly repeated over time. Very often, in Team Sports, these patterns are referred as "Set Plays" or "Set Pieces" situations, namely situations that could origin from a free kick, as it happens in Football or in Rugby.

We can call them **"Competition Invariants"**, since they recurred as consistent game or athletic discipline structures, deeply characterising these sports.

Specific "Set Plays" are identified in different Team Sports and they need to be practised and trained precisely, in order to exploit all the potentialities they have, according to many researchers (Reilly et al., 1993, 1997; Kormelink et al., 1999; Jonsson et al.; 2001; Laird et al., 2003; Hughes and Franks, 2004; Carling et al., 2005; Ciuffarella and Ruscello, 2008).

Just as an example in the World Hockey Olympic Qualifier Tournament 2008, held in Victoria (Canada), of all the goals scored during the Tournament, about the 50% were scored in a specific **Competition Invariant**, namely the "Penalty (Short) Corner" (Ruscello et al., 2008).

Through appropriate Match Analysis procedures it is possible to precisely recognise and reconstruct these Competition Invariants, in order to train and improve them in specific training sessions and allow the players to handle these situations better and better.

Analysing the Competition Invariants in fighting sports (Sacripanti,1989, 2007) like the Judo, it is possible to:

1. improving the one's own technique in match-like situations;
2. adapting or fitting the one's own technique to the opponents' one.In Team Sports several Competition Invariants have been recognised and deeply analysed, such as:

1. Blocking (Volleyball)

Penalty Corner (Field Hockey)

2. Free Throw (Basket)

3. Corner (Football)

4. Free Kicks (Rugby)

5. The Scrum (Rugby)

The relevance of the **Competition Invariants Analysis,** in the broader context of Match Analysis, is gaining momentum day by day. In Chapter 13 of this thesis an example of Match Analysis, investigating the specific Competition Invariant called "Short Corner" in Field Hockey is provided.

8.3 The skills and the local strategies

Sports skills can be put into two different categories:

1. **closed skills**
2. **opened skills.**

Closed Skills are skills that take place under fixed, unchanging environmental conditions.

They are predictable and have clearly defined beginning and ending points. Examples of closed skills are performing an exercise in gymnastics, a dive in diving, etc.

Open Skills usually take place under the conditions of a temporarily changing environment. Decisions and adjustments must be made "on the run." An example of an open skill would be a playmaker adjusting who he's passing to based on the location of defensive players.

Sport skills can be placed on a continuum having what are called "closed" and "open" categories.

Figure 4 The Open – Closed Skills continuum.

8.3.1 The "Closed Skills"

In figure 4) the Closed skills are at the right end of the continuum and take place under fixed, unchanging environmental conditions. As reported previously they are predictable and have clearly defined beginning and ending points. Feedback plays a minor role once the skill is initiated and they are usually "self-paced" in the sense

that the performer begins movement when he is ready. Gymnastics, Diving, Bowling, Golf, Archery, and competitive Weight-Lifting are definitely closed skill sports (Magill, 1993).

8.3.2 The "Semi-closed Skills"

Closed skills can also be an integral part of more complex activities (e.g. the free throw in basketball, the free kick in football, etc.), even though most of the skills in those sports involve much more detail. In order to better define this particular area of the continuum, we proposed to call these specific skills as "**semi-closed skills**", thus underlining the specificity of these motor abilities, that need a high level of stability (like in gymnastics) and, in the same time, they requires a high ability in reading the ongoing situation (like in football or basket), in order to be able to adjust the skill to be performed up to the very last second available and to cope with the opponent's countermove in a efficient way.

8.3.3 The "Open Skills"

Open skills, which are at the left end of the proposed continuum in figure 4), usually take place under the conditions of a temporarily or spatially changing environment.
They are based on the continuum feedback process going on during the whole performance. The complex of the movement is finely regulated by the Central and the Peripheral Nervous System, which continuously supervised and adjust the performed skill in accordance to the ongoing competitive situation (Meinel, 1984; Weineck, 2001).
A major difference between closed and open skills is the reliance on feedback in the decision making process. It may be visual feedback, or it may involve another cue.
Defensive players, for instance, are taught to utilize both visual cues and "pressure" cues (i.e., the type, angle, and direction of the block they are facing).
These are known as "forced-pace" skills, and they are extremely complex due to the fact that the athlete must make quick decisions and get his body to react with precision in a very short period of time.
Due to the variability, dependence on feedback, and the mental pressure to make quick decisions under pressure, several scholars (Meinel,1984; Magill,1993; Weineck, 2001) suggested that **open skills require a higher level of learning than closed skills**.

8.3.4   The invariant features in Team Sports: analysing the "*Set Plays Situations*"

Set plays such as free throws or hits, free kicks, corners and penalty corners (in field hockey) take place frequently in team sports, and while the local strategies employed in both attack and defence need not be complicated, it is essential that all players involved understand what is happening (Whitaker, 1992).

As reported further in this thesis, (chapter 13) analysing the **Set Plays Situations** could be considered a promising line of research within the Team Sports methodology (Wein, 1993; Laird et al., 2003; Ruscello et al., 2008), since many goal opportunities seems to be strongly related to the exploitation of such peculiar situations.

As reported by Taylor (1988) many games, in most Team Sports, are won or lost by the efficiency of the attacking and defensive formations at set plays.

Important examples of how important could be considered these specific "Local Strategies" in Team Sports are highlighted by numerous researchers (Jinshan et al. in Reilly, 1993; Luthanen in Reilly, 1993; Olsen and Larsen in Reilly, 1997; Chiarella Sforza et. Al. in Reilly, 1997; Carling, Williams and Reilly; 2005; Ciuffarella and Ruscello; 2008; Ruscello et al., 2008b) .

In Football and Field Hockey, a significant proportion of goals are scored either directly (i.e. a first-phase goal where the ball is not touched by the opposition) or indirectly (i.e. a second phase goal where the ball is cleared and then immediately played back into the danger zone) in domestic and international soccer or hockey. When second-phase goals are considered, almost half of all goals are scored via this route. The proportion of goals scored from open play and various types of *set plays* are provided in the Table 1 (Soccer, World Cup , 2002) and Table 2 (Hockey, Women Olympic Qualifier, 2008).

	Total	%
Free Kick	27	17
Corner	21	13
Throw	17	10
Penalty	13	8
Open Play	83	52

Table 1 Source of goals in the 2002 World Cup (Carling et al.; 2005)

	Total	%
Total Field Goals	29	49
Total PC Goals	29	49
Total PS Goals	1	1,7
Total Goals	59	

Table 2 Source of goals in the 2008 World Olympic Qualifier – Women (Ruscello et al.; 2008)

This breakdown is fairly consistent across domestic and international soccer and hockey, with *Free Kicks* being the most important in soccer and *Penalty Corners* in hockey. It is also noteworthy that in 1999 Women's Soccer World Cup, the four semi-finalists scored almost 58% of their goals from set plays.

In international soccer, team have an average of 12 indirect free kicks, 2 direct free kicks, 17 throw-ins and 5 corner kicks in the attacking third per game. The overall frequency of set plays has declined slightly in recent years (Carling et al.; 2005), particularly at international level. In contrast to the observed decrease in set play frequency, there has been a significant increase in efficiency, with more goals scored from fewer set plays. So occurred in Hockey, where the International Board of Rules adjusted several times over the recent past years the Rules governing the game, particularly referring to "penalty corners" situations, which are the most important "set play" in modern hockey, in order to "limit" the extraordinary relevance of this particular aspect of the game.

Generally speaking, successful teams are far more efficient than their opponents at scoring from set plays (with a typical set play goal ratio in football of 1:7 - roughly 14% - for successful teams compared to 1:15 - 6.6 % - for opponents).

Some values for international top level Hockey are reported in the tables below:

	PCs For			PCs Against			FG For			FG Against			PS
	#	Gls	%	#	Gls	%	#	Gls	%	#	Gls	%	
ARG	34	7	21%	27	4	15%	31	5	16%	30	6	20%	2
AUS	27	6	22%	19	1	5%	48	10	21%	28	3	11%	0
CHN	15	2	13%	32	2	6%	27	8	30%	34	6	18%	1
ENG	31	3	10%	31	6	19%	25	3	12%	40	7	18%	0
KOR	28	4	14%	37	8	22%	20	4	20%	42	9	21%	0
NED	34	5	15%	23	6	26%	46	5	11%	23	4	17%	1
Tot	**169**	**27**	**16%**	**169**	**27**	**16%**	**197**	**35**	**18%**	**197**	**35**	**18%**	**4**
Avg	**28**	**5**	**16%**				**33**	**6**	**18%**				

Table 3 - BDO Hockey Champions Trophy, Sydney, 2003 –Final Statistics

Legend: PC= Penalty Corners; FG= Field Goal (Open Play); PS= Penalty Stroke; Gls= Goals

The importance of preparation and planning at set plays is highlighted. An example of Set Play Analysis in Hockey is provided along this thesis, in chapter 13.

8.4 Introduction to the Database Theories, the Data Mining Routines and related Technologies

The data collected through the relevant procedures and produced from the match analysis systems must somehow be stored in order to be analysed, retrieved, compared and presented in a quick and efficient manner. A *database* is nothing more than an organised collection of common records that can be searched, accessed, modified and visualised[1]. Databases, which are part of only a few modern systems, also have many other features, as follows:

- They provide an excellent means of looking at past performance by analysing trends over a defined period of time.
- They can store and provide any type of data on demand (e.g. according to time, player, position, action type, speed).
- They can combine data on all aspects of performance, such as physical, technical and tactical information.

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[1] More info on http://www.devarticles.com/c/a/MySQL/Introductory-Database-Theory-Systems-And-Design/

- They allow any type of statistical data analysis and presentation through high-quality graphical output.
- Data on several matches can be entered to establish a performance baseline. Improvements following a training programme can then be evaluated by comparing the new data against the original baseline data.
- They can create future performance goals (e.g. greater number of sprints next season and decreased sprint recovery time for a player) and perhaps create predictive models of performance (e.g. repeated and detailed analysis of an opponent's tactical performance will provide a model on how the team plays and the likelihood of its tactical play in future games).
- It is possible to make a database interactive with other databases containing information on areas such as medical and physical assessments. Combining this information can only lead to a better overall understanding of player performance.

A practical example of how a database can help is to look at the physical performance of a player combined with other tactical or technical data[2]. The database can be queried to know how often over a ten-game period the player's work-rate drops at the end of the game (e.g. distance run, number of sprints and recovery times). The database can then provide technical information on the passing success rate as well as positional data at the end of the match. This information can then be graphically displayed to show that the player's performance tended to decrease at the end of the match (low passing success rate and stayed in more defensive areas, hence also contributed little to attacking play).

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[2] More information and suggestions about this issue may be found in "Conference Abstracts – Verona-Ghirada Team Sport Conference", held in Treviso (Italy) in June 7-8th , 2008, published by "Coaching & Sport Science Journal", volume 3, Number 2; May-August 2008.
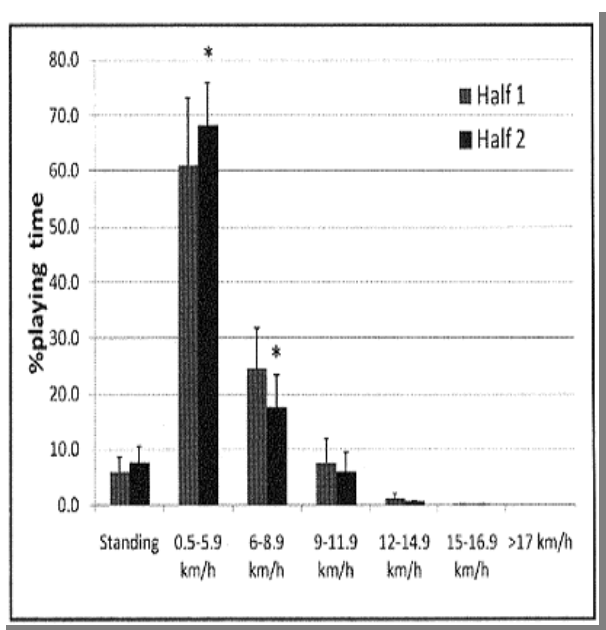
Figure 5 – Percentage of total time spent in each velocity zone for first and second half (Buchheit et al., 2008, in *"Coaching and Sport Science Journal";* **Vol. 3, Num. 2; May-Aug. 2008)**

A specific fitness training programme may then be implemented and an analysis of the following ten games can be made in order to evaluate whether the training programme was a success. Care should, however, be taken when comparing data obtained from past performances. Soccer is constantly changing, and data that were recorded a number of years ago may no longer be pertinent. For example, comparing two different cup-winning teams from the 1980s and 1990s is difficult, as many factors have changed (e.g. rules, better equipment, improved fitness and diet). Attention should also be paid when attempting to "profile" or create a model of performance on how a player or team plays. The number of games chosen, the playing standard and the type of data collected will affect the accuracy of the profile.

A database may also be used to store short digital video clips or selected reconstructions of past performance. For example, a coach may want to visualise and present every goal conceded from a set-piece situation over the season (Ruscello et al.; 2008b).

A simple database query will allow these actions to be immediately retrieved and the video clip shown to the players to highlight certain tactical issues.
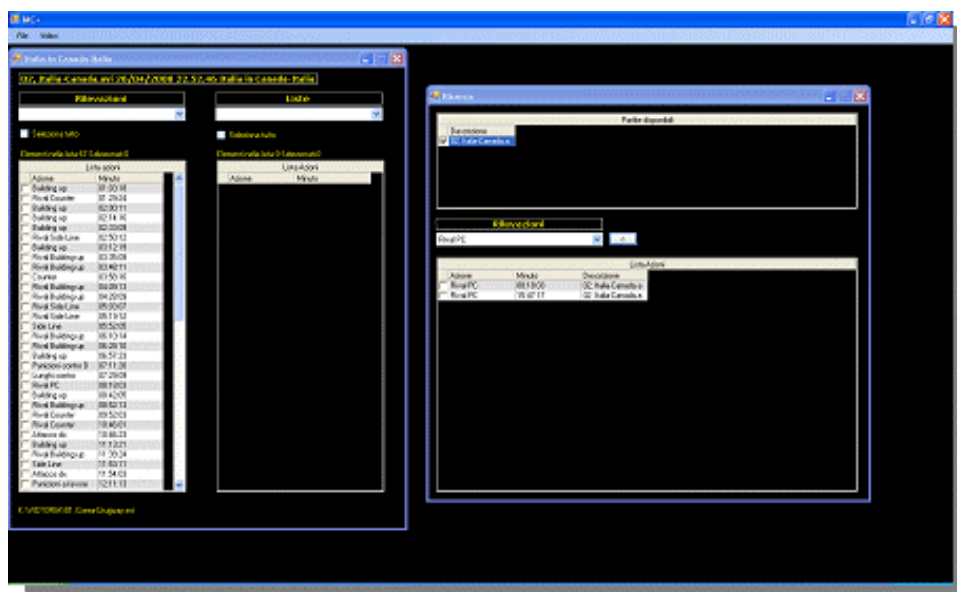
Figure 6 A Sport Video DataBase – The "IAC" (Iaccarino-Ruscello, 2008)

The coach may then ask the database for examples of successful performance (e.g. where the ball was cleared) to demonstrate specific differences. These performance records can also allow detailed comparisons of the player's abilities for the purpose of team selection and development. For example, trend analysis may lead to the choice of a player's most effective playing position or detect a particular weakness in his/her game and calculate the best possible training programme to improve performance.

Expert systems using **artificial intelligence** (i.e. Data-Mining routines as in the case presented in chapter 13) may help in these processes by allowing the skilled knowledge, playing and selection criteria of top-level coaches to be transferred into a computer database, (Ruscello et al.; 2008b) which will then provide advice on implementing these criteria in the specific development of the player.

8.5 Introduction to the Specific Training and Coaching Methods

It is human nature to struggle constantly for improvements in what we do and how we do things. Sport is no different, and many coaches are constantly looking for ways of enhancing performance. Throughout this Thesis we have tried to support the idea of how and why Match Analysis can play an important part in improving performance. The match analysis process will undoubtedly be affected by current and future technological developments. We will try then to provide a global overview of what could be the possible future scenarios involving the Match Analysis processes.

8.5.1 New methods of collecting Data

The technology used to analyse player performance will no doubt continue to move forward in the way it already has done over the past few years. New and improved computer and video systems will be used in the collection, analysis and application of match data. Many companies involved in this field are constantly looking at ways of improving the collection of data in terms of **speed**, **quality** and **quantity**. As stated previously in this Thesis (Chapter 2), these methods will no doubt include *coding logics*, *voice recognition* and *global positioning systems* (GPS).

Coding logic

Current coding methods involve the time-consuming and repetitive input of factors such as:
- Types of Match, Site, Date, etc.
- Weather Conditions
- Player names
- Actions
- Positions
- Scores
- Etc.

As is mentioned in Chapter 2, voice recognition is one particular means of speeding up the coding of matches[3].

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[3] For example, see http://www.nacsport.com

The majority of systems will probably integrate voice recognition in some way. Systems will also no doubt use some form of special coding logic to save time when inputting data.

Consider a simple situation involving a pass between two players leading to an off-target shot.

A logic could be used to reduce the amount of information to be coded. Figure 9.1 presents a schematic pitch representation of the match action. First, the analyst inputs the player's name (here: A) by voice recognition and clicks the position where the ball was received on the schematic pitch displayed in the computer interface (the time is automatically recorded, thanks to the time code).
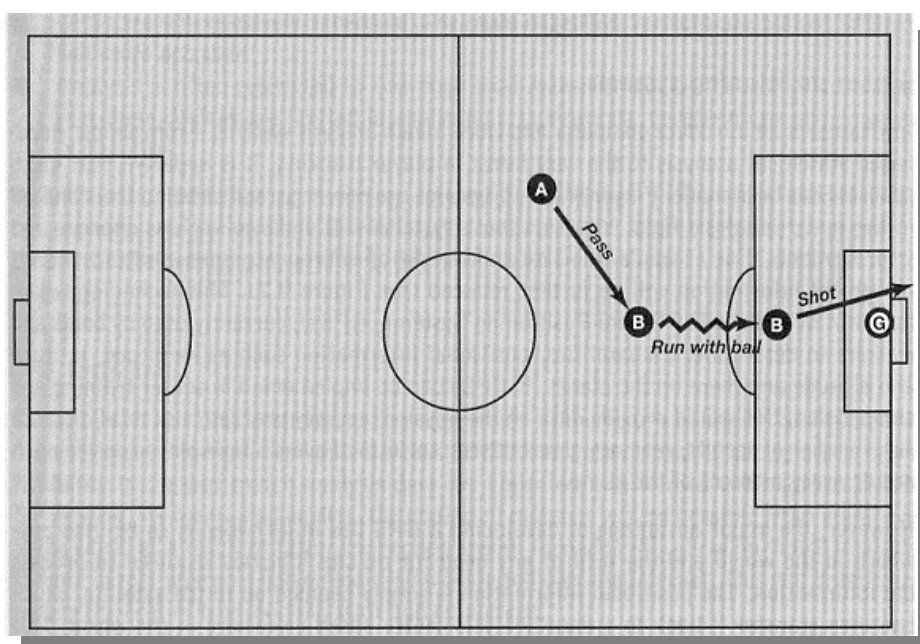

Figure 7 A possible coding of a simple match action such as pass, run with the ball and shot, made easier through the use of a coding logic and voice recognition (Carling et al., 2005)

Voice recognition is again used to input the other player's name (here: B) and the position clicked on the pitch. As the ball is transferred from one player (here A to B) to another in the same team, the computer recognises this as a successful pass (the two positions also provide information on pass direction and length).

The process of simply clicking two different positions and inputting two names by voice recognition avoids having to look for and click on the pass button in the interface. The analyst then clicks a further position where B touched the ball again and then input a shot by voice recognition. The ball position is clicked (the shot went wide) behind the goal line. As B kept possession, there is no point in

inputting the player's name again, therefore saving another click (two different positions also mean a run with the ball). Also, clicking the position behind the goal where the ball went wide means that the computer automatically recognises that the shot was unsuccessful. Finally, as the ball goes behind for what obviously had to be a goal kick, the computer automatically calculates from the position of the last click that the next action must be a goal kick, so avoiding the input of yet another match action. Although sufficient practice is needed to learn such coding strategies, the time required to analyse a match could be drastically reduced, especially when combined with voice recognition.

Figure 8 - NAC Sport Elite – Voice Recognition Device

Other data collection methods

Finger touch-sensitive screens will be employed by some systems, and new optical technology developed to record positions of actions on the interface pitch through measuring where the eye is looking [4].

Figure 9 Eye-tracking Technology – Neurolab – Istituto di Medicina e Scienza dello Sport

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[4]more info at: http://www.acquacetosaricerca.it/
 http://scienza.coni.it/fileadmin/documenti/pdf_prestazioni/federazioni/FIS2006.pdf ;
http://scienza.coni.it/fileadmin/documenti/pdf_prestazioni/federazioni/FPI2006.pdf ;

These methods will gradually phase out the use of the mouse and keyboard. Systems will also allow several operators to work simultaneously on the same match, recording through a local network or over the Internet. The more quickly the system can produce the required results, the more attractive it is to coaches.

The ultimate aim for future systems is the development and application of intelligent technology to analyse match performance without any human input. Using sophisticated player and ball tracking methods, digital video and sound, these systems will automatically recognise and record every action and movement as it happens on the pitch. Such a system is a few years away from being developed, but rapid technological developments may allow this type of system to see the light of day within the next decade or two (Carling et al.; 2005).

Global positioning systems

In Chapter 2) we introduced computer and video match analysis systems. From simple video-based statistical analysis to the very latest in player tracking, it is apparent that much progress has been made. Player tracking systems are now regarded as being the standard in the match analysis field. Yet even these systems will undergo various changes and improvements. For example, the size and weight of microprocessors used to transmit movement information will be further reduced. This technology may, however, be replaced by Global Positioning Systems (GPSs), currently used by boats and walkers to determine, via satellites, positional information such as longitude, latitude and altitude anywhere on the planet. Some promising devices are already available and they can provide a huge amount of information to the analysts, integrating many and different data (i.e. using cardio measures, such as HR, accelerometers, etc.) about the ongoing match or game[5].

The Internet

The Internet will play a similarly important role in the future of match analysis. The incredible development over recent years of this computer network allows much more flexibility in the way match analysis data are collected, transferred and made available for viewing. As mentioned earlier, the coding of matches will be possible from anywhere in the world as a result of faster connection speeds (broadband), allowing match analysts to work in real time on a game recording transferred over the Internet. This will drastically reduce the cost of transporting staff and equipment.

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[5] see: http://www.gpsports.com/

As the matches will be coded live, the data will be processed in real time and sent back for immediate analysis and evaluation by the coaching team.

This can easily be done via email. Many modern systems provide an output function to publish data automatically (such as video sequences or graphs) into Web format for future retrieval. These data can also be displayed on a Web site address for usage by any coach or player, anywhere in the world. Recent faster connection speed has made this transfer process even easier. Postmatch, the coach may want to organise a live Web-based video conference to discuss the performance with staff members back home.

It is also important to mention that the World Wide Web is also a fantastic means for sharing information and ideas. Many coaches are now using forums, Web sites and live chats to search for and share new ideas. Web sites containing databases of training drills and articles on fitness and tactical issues are now commonplace, although quality of content vary markedly. However, any coach should be aware of the wealth of free information currently available on the Web twenty-four hours a day[6].

Data and Results

Future improvements also concern the way the results from Match Analysis are processed and used. Digital video technology will continue to make progress in terms of quality and price. One of the current limitations of digital video is the large amount of computer storage space required. The larger the video screen size recording and the higher the quality, the greater the hard disk/CD/DVD-ROM space required. Currently, a DVD-ROM often only contains one match recording, and even this has often undergone compression to reduce file size and therefore quality. Coaches may currently see digital video footage as being less desirable than its traditional analogue counterpart, because of the poorer image quality and size. Future digital video techniques will allow large-screen and extremely high-quality footage to be comfortably stored on disk format, thanks to improved non-degrading compression techniques. Furthermore, the cameras used to record the footage will provide easier and better-quality recordings thanks to intelligent automatic image adjustment, which will avoid or reduce problems such as light exposure.

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[6] more info at: http://www.coachinghockey.com/drills/index.jsp

Currently, tracking systems allow a reconstruction in two dimensions of the positions, movements and actions of every player on the pitch at every moment of the game. Using the same data, this work has recently been extended to three-dimensional reconstructions using player representations (see Figure 10).
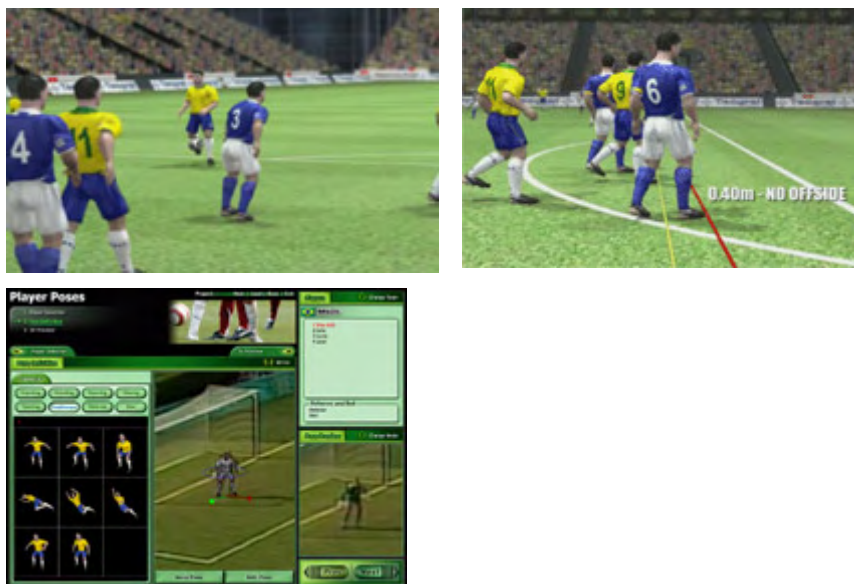
Figure 10 - a match reconstruction in 3D created by the Israeli sports technology -
http://www.orad.tv/en/page.asp?id=188

However, both two- and three-dimensional analysis are restricted, as they do not show any real behavioural or technical information, unlike a video recording. For example, the two-dimensional analysis may show that when the goal was conceded, a player's marking and position were correct. However, match video might show that the player was seemingly watching the ball and was therefore caught out by the forward. Therefore, an ideal futuristic system would combine tracking data with an exact reconstruction of player postural information such as which way the player was facing and looking, and his/her body positions as well as technical skills such as how and where the ball was struck.

The Soccerman project[7] developed by the Institute of Computer Science and Applied Mathematics based at the University of Bern is a first step in this direction.

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[7]

http://www3.interscience.wiley.com/journal/119040873/abstract?CRETRY=1&SRE
TRY=0

This type of system would allow for the first time the analysis and evaluation of every aspect of performance.

Expert systems (an application that uses a knowledge base of human expertise to aid in solving problems) using artificial intelligence (which is the branch of computer science concerned with making computers behave like humans) will probably start top lay a major role in the modelling and prediction of performance (Carling et al.2005; Sacripanti, 2007; Ruscello et al., 2008).

Expert systems will be designed to analyse and understand match performance and develop the most efficient and optimal training sessions. For example, the expert system computer will advise on how performance can be improved by delivering information on areas such as fitness (figure 11), and will design tailor-made training schedules.
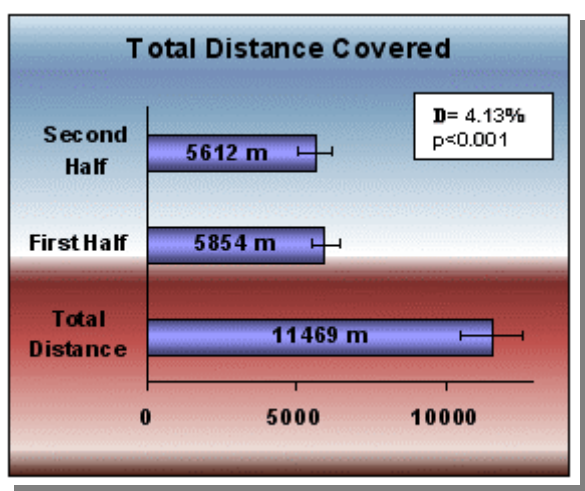
Figure 11 – Soccer Analysis – Castagna, 2003

This will be possible as these systems will combine qualitative and quantitative information derived from the knowledge and expertise of coaches and technical staff (e.g. fitness trainer, defensive coach) and from data obtained through training sessions and matches. The system will then measure the progress made in both matches and training, answer coach and player questions, supply explanations on performance-related issues and apply or suggest ways of improving the training model.

These expert systems may also play a part in helping coaches to analyse live performance. For example, a system can be programmed to provide intelligent information on performance (using both past and current information) and make decisions which are then practically translated into coaching terms.

New Training Methods

Coaches at all levels face the difficult task of creating challenging training sessions for their team on a regular basis. One particular means of improving player learning is by aiding players' understanding of the tasks they must carry out. Indeed, clear and precise instructions are an important component of any learning process.

Information Technology is heavily influencing even this aspect of the training process, providing many specific tools suitable to consistently help the coaches in their task, as in *Training DataBase*, where thousands of drills could be stored and presented even directly on the pitch to the players.

Taking this approach even further is the use of **virtual reality**, (Bideau et al., 2004; Del Percio et al. 2007) which may be defined as the simulation of a real or imagined environment that can be experienced visually in three dimensions with sound, tactile and other forms of feedback. This approach has previously been used in American football as a training mechanism by simulating the environment of elite competition through the use of material such as cyber eyeglasses, data-generating gloves and simulators. This environment will allow players to experience and relive all the sensations (e.g. crowd noises, wind, rain) they usually feel in real competition as well as providing visual and motion cues on performance.

Figure 12 – Virtual Reality and Fencing – NeuroLab CONI, Italy, 2008

Virtual reality aims to speed up learning time and the achievement of optimal performance. The system will also use relevant information on all aspects of playing performance such as fitness and tactics to maximise the effect. For example, a goalkeeper could play in a virtual soccer match simulator (Bideau et al. 2004). The player sees, experiences and participates in the game from a first-person

perspective. The computer can recreate match actions such as penalty kicks or crosses. The goalkeeper's performance can then be analysed during each particular action and virtual reality then used to work on and improve specific techniques. Players wearing a computer-linked virtual reality suit will be helped and guided through the exact movements required, again using an expert model.
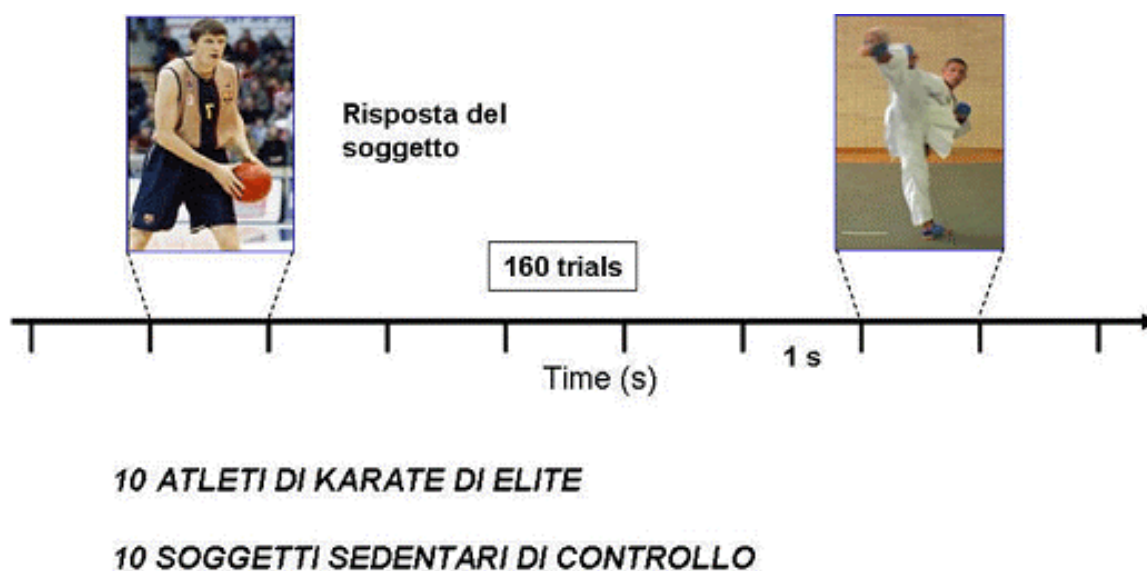

Figure 13 Virtual Reality and Karate – NeuroLab CONI, Italy, 2008

The virtual reality system can be used to train goalkeepers to anticipate the direction of a penalty taker's shot. Such an approach has already been used in cricket and tennis, and a similar system has been developed to train decision-making skill in American football[8]. This virtual reality approach is also useful for players who are injured or recovering; it means that they can practise in a contact-free environment.

8.5.2 Drug Detection and Match Analysis

Drugs affect the physiology and performance of players (Mottram, 2005). Laboratory-controlled measurements are generally used to test for improvements in

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[8] http://www-vrl.umich.edu/project/football/

performance by examining physiological factors such as heart rate, oxygen uptake, lactate levels, muscle strength or power. In team sports, drugs aim at improving aerobic and anaerobic capacity. However, could match analysis data play a role in detecting drug abuse by measuring improvements in actual match performance?

In studies on athletes, various substances including creatine, which is not banned, have been shown to improve sprint times and the ability to recover in a shorter period of time. A detailed work-rate profile of a centre-forward's high-intensity actions may indicate that the player's maximal sprinting speed has increased and he/she sprints more often and spends less time in recovery activities. When compared to previous analyses of the same player, this indicates a significant gain in physical performance and may warrant further investigation. Similarly, **Erythropoietin** (**EPO**) has been shown to increase maximum aerobic power. This drug may have implications, as V_{02} max is significantly correlated to the distances run by soccer players. A midfielder in soccer or field hockey, who regularly ran around 10 km during a match is suddenly achieving distances of around 11 km, amounting to a gain of around 10 per cent. Neither the tactical role of the player nor the team's playing system has been changed. As the endurance capacity of soccer players is highly linked to work-rate performance, this may once again imply the use of drugs. However, match analysis and in particular work-rate profiles may in theory play a small yet important role in helping detect drug infringements.

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Chapter 9

A third level CTC Process:
The Global Strategies and the Tactics

9.1. Global Strategies

A **strategy** is a long-term plan of action designed to achieve a particular goal. **Strategy** is differentiated from **tactics**, or immediate actions, with resources at hand by its nature of being extensively premeditated, and often practically rehearsed.

The word derives from the Greek word *"stratēgos",* which derives from two words: stratos (army) and ago (ancient Greek for leading). Stratēgos referred to a "military commander" during the age of Athenian Democracy.

Strategy should always be designed to provide competitive advantage. Military strategy is that contest of strategy between opposing military forces. Because of its ability to provide competitive advantage, strategy is differentiated from planning. Strategy can also be termed as direction that enables companies to achieve goals and objectives.

In the field of business administration, "strategic consistency" is when the actions of an organization are consistent with the expectations of management, and these in turn are consistent with the market and the context. (De Geus, 2007).

In sport context, the concept of strategy has developed several meanings, often describing situations that can be more appropriately assigned to the tactic domain (the ability to cope efficiently with the present and real situation). According to Sacripanti (2007b), strategy may be better defined revisiting a general definition given by von Neumann and Morgenstern (1944-47), that is: *"strategy is a general plan that specifies which choices a player must select, for each upgraded available information he may acquire, in any given istant of the match, in compliance to the information patterns that the game's rules allows in that case."*

We may also define Strategy, (Sacripanti, 2007b) as " *the plan or the flexible merge of different plans, based on the overall coordination of the efforts, harmonised with the relevant motions, that aim at prevailing over the opponents and achieve the victory, whereas Tactic is the ability of using correctly the transient phase".*

According to this definition the differences between Strategy and Tactic may be summarize as follows:

1. a strategic plan may be prepared **in advance** and it is based on the rationale analysis of the situation (pro-active action);

2. a tactic skill is based on the **momentarily intuition** (the ability of reading the game; reactive and pro-active action), thus it is impossible to prepare it in advance.

Often in sports environments most of the strategical and tactical training is based on the application of general principles of behaviour, (***the strategies***) which are known and shared by the different players composing a team.

Usually in Team Sports, such as Football, Hockey, Basketball, Rugby, etc., the general strategies refer mainly to the two different phases of the game:

1. **the offensive phase**
2. **the defensive phase**

9.1.1. Offensive strategy general principles

The goal of offensive strategy is to move the ball to score more points than the opponent and to prevent the opponent from doing the same by reducing the amount of game clock time remaining, denying the opponent possession of the ball, and preventing them from advancing the ball into scoring position (Teodorescu, 1981). In order to do so, coaches and players choose to execute selected plays based on a variety of factors including the opponent's defensive strategy; the talent, skill, health, and experience of the players on both the offensive and defensive teams; the amount of time remaining before halftime or the end of the game; and the number of points that either team would need to score in order to take the lead and win the game.

9.1.2. Defensive strategy general principles

Defensive strategy is the placement and assignment of defensive players so as to check and frustrate the progress of the opponent's offence. Defensive strategy is usually more fluid and variable than offensive strategy (Teodorescu, 1981; Whitaker,

1992; Wein, 1993). The most effective element of defensive strategy is to take possession of the ball from the offensive team, referred to as a turnover of possession. Defensive strategy involves, as much as possible, the prevention of the opposing offence's scoring. However, space gained and time of possession must also be limited to be consistently successful. While doing so, the defensive players may also attempt to gain control of the ball and score points/goals themselves. General defences can be deployed which can respond to a broad range of offensive plays, or highly specific defences can be used, in the expectation of a very specific type of offensive play being executed (e.g. the prevent defence against a long pass.) There are many different categories of commonly seen defensive strategies.

A ***strategy sport*** is a game in which the players' decision-making skills have a high significance in determining the outcome (Harre, 1982; Taylor, 1988; Verchoshanskij, 2001a). Team or situation sports include this element to a greater or lesser degree, making demarcation difficult. It is therefore more accurate to describe a particular sport as having a certain degree of strategic elements, as in being mainly based around strategic principles.

Strategy (and **tactics**) is usually contrasted with **luck**, the outcome of luck-based games relying on probability. Games and Sports exist on a continuum from pure skill to pure chance, with strategic sports usually towards the skill end of the spectrum.

9.2. Tactic

Tactic is a planned behaviour aimed at competing in individual or in team sports, based on the own performance abilities and the opponent's ones, as well as on the external conditions (Zech, 1971).
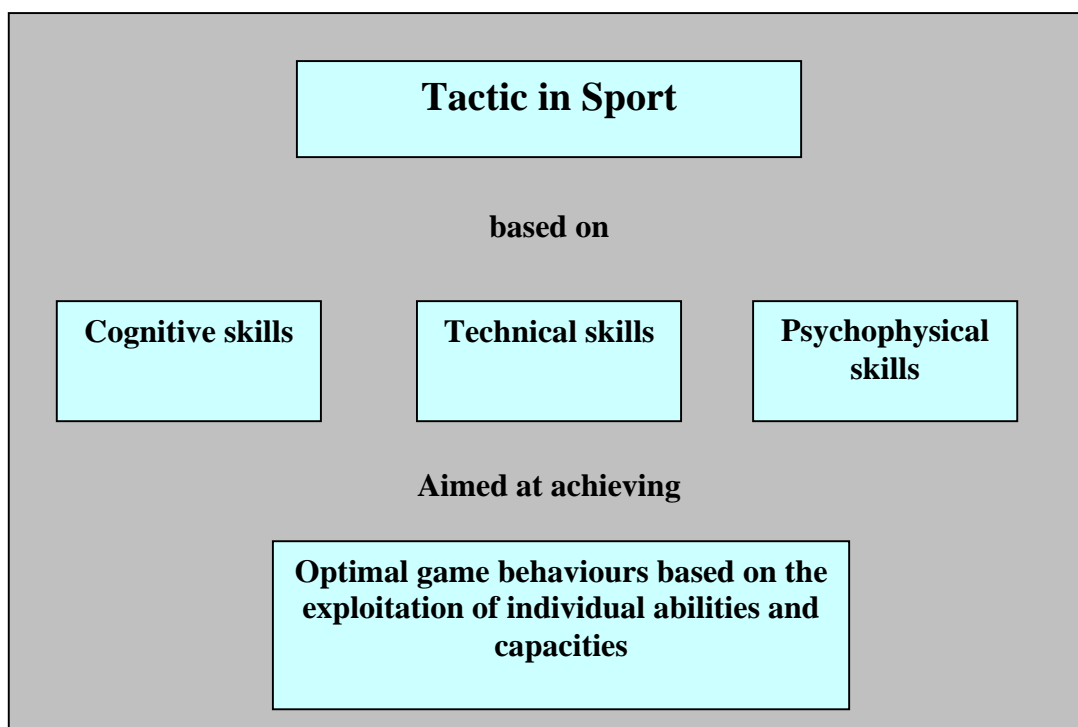
We can consider two different aspects in Tactic:
1. **General Tactic**
2. **Specific Tactic**

General Tactic refers to the general rules that govern the behaviour in a tactic shape. Specific Tactic is about the ability to solve specific tasks in a given athletic discipline or sport, thus needing a specific and continuous training (Weineck, 2001).

Figure 8.1) provides a general overview of what a Tactic Action is and its components:

Tactic in Sport

based on

Cognitive skills   **Technical skills**   **Psychophysical skills**

Aimed at achieving

Optimal game behaviours based on the exploitation of individual abilities and capacities

Figura 1 - Tactic Action components

An optimal behaviour of a player during a game definitely requires tactical abilities. But every tactical plan may be realized only if a suitable technical background is available along with the psychophysical requirements, and the relevant psychic, cognitive and motivational capacities (Teodorescu, 1989; Weineck, 2001). Every team sport expert knows full well how important is the interaction of the various aspects that combine to create the optimal "team or combat sport" performance (Harre, 1982; Teodorescu, 1981; Weineck, 2001; Ruscello 2008; Sacripanti 2008a, 2008b).

Referring to the above reported, Sonnenschein (1987) suggested: "often people underestimate how sport performance are heavily affected by the cognitive, psychic and motivational processes, that are trainable as well as the fitness or technical components."

218

Psychic and tactic capacities are deeply integrated into a complex system of internal processes of regulation. Their efficiency has a major role in the full exploitation of the individual potential as a player.

Control Capacity is a key factor in the Tactic Behaviour, as shown in table 1).

CONTROL CAPACITY	**WILL**	Capacity to prevail over difficulties and obstacles subjectively perceived
	DECISIVENESS	Capacity of decision making and of performing the relevant motor actions
	SELF -CONTROL	Capacity of controlling under the cognitive sphere the emotions
	COURAGE	Capacity of facing consciously risks and danger
	PERSISTENCY	Capacity to achieve an objective over long periods, despite delays or failures
	CONCENTRATION	Capacity of perceiving consciously and with the maximal clarity a limited part of the perceiving range, contemporarily excluding the action of other stimulus
	RESISTANCE TO CONCENTRATION	Capacity of concentrating over a long period

Table 1 – The different Control Capacities (Baumann, 1986)

Other Control Capacities, fundamental in performing Tactic skills, are those ones related to the ability to efficiently cope with internal and external obstacles and difficulties, as reported in table 2)
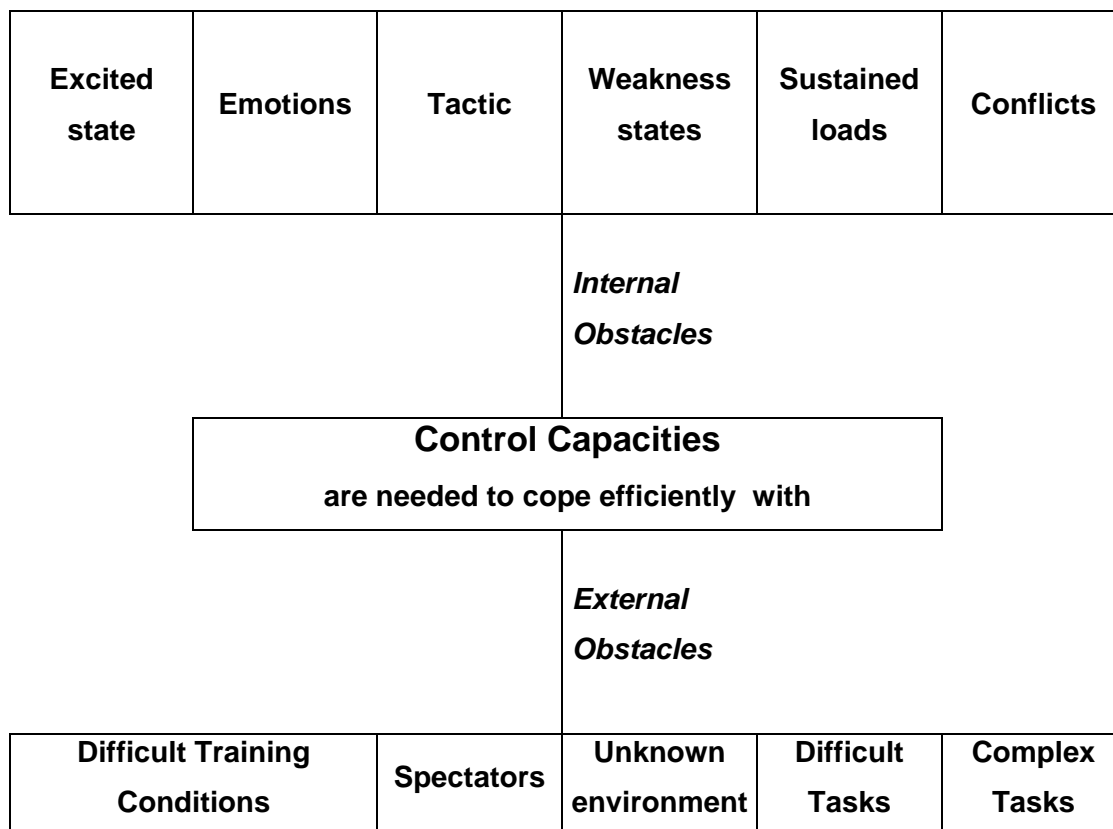
Excited state	Emotions	Tactic	Weakness states	Sustained loads	Conflicts

Internal Obstacles

Control Capacities
are needed to cope efficiently with

External Obstacles

Difficult Training Conditions	Spectators	Unknown environment	Difficult Tasks	Complex Tasks

Table 2 – The different tasks of Control Capacities (Baumann, 1986)

Harre (1982) suggested that Tactical Behaviour is based on two different structures:

1. the **organization** of the Match or of the Sport Event;

2. the **actual conduction** of the Match or of the Sport Event.

He meant with the concept of *organization* the need of preparing before the game or match all the means that will allow the athlete or player to compete at his maximum potential. With the concept of *actual conduction* of the match or game, he meant the ability to cope in the real time with the always-changing demands that a match usually requires. The relationship with the process of training and its control is clear. Match Analysis has got an important task in this sense, in order to provide the crucial information about Strategy and Tactic in Team Sports disciplines (Hughes and Franks, 2004; Carling et al., 2005; Sacripanti 2007a e 2007b) .

In order to define a possible intervention of the Match Analysis process in providing significant information about the Strategy and the Tactical side of the Football game, the author of this thesis and Doctor Ciuffarella, from University of L'Aquila, Faculty of Motor Sciences, designed a research project investigating the performance of a specific role in this sport: the Centre Back playing in a 4:4:2: (or 4:4:1:1) system. An article from this research has been already published by the Italian Sport Science Magazine "SDS – Scuola dello Sport" (Ciuffarella and Ruscello, 2008)

9.3. Function of "Semi-Closed Skills" in strategical planning

According to what has been previously reported in chapter 8), the semi-closed skills play a major role in the strategic preparation of a team and of a player (Sacripanti, 2007a, 2007b; Ciuffarella e Ruscello, 2008; Ruscello et. Al.; 2008b). Often these skills are performed during the game phase called "set play", where the ball is standing and all the player are waiting for a first move of the person taking responsibility of the forthcoming action. These actions, as reported previously, may be also called "competition invariants" (Sacripanti, 2007a, 2007b) and they need a complex and repeated period of training in order to be stabilised and standardised. Thousands of repetitions are usually required in order to grant high level of consistency under pressure, namely in stressing situations where the players have to cope efficiently with internal and external difficulties or obstacles (see table 2).

As reported further on this chapter, in football and other team sports, a lot of the strategical planning is about organising efficiently the routines of tactical behaviours, which provide many goal opportunities, such as in Corner, Penalty Corners, Free Kicks or Throws, etc., in Football, Rugby, Hockey , Basketball, etc.

In modern Match Analysis (Kormelink and Seeverens, 1999; Jonsson et al., 2001; Needham, 2003) a lot of work is done in order to find the relevant and crucial features of these complex patterns performed during the matches, both by the own team and by the opponent's. The role of Match Analysis is critical in order to provide effective information about both the team competing and to let future planning, regarding the improvements of these skills.

9.4. Matches Databases and Off-Line Analysis

A usual procedure in Match Analysis is taping an event for future processing and subsequent analysis (Sacripanti, 2004).

In recent years the Information Technology provided very efficient tools that help consistently the work of these analysts. An important role is played by the Database technology and the related software, that allow to store permanently and safe huge amount of data, most of which is video.

The possibility to play as much as it is needed a specific video, looking for the crucial information and the possibility to index the relevant frames, in order to recall them later or assemble lists of homogenous events, have allowed the Match Analysts to perform efficient and safe analysis of the observed events, and even to try prediction based on a statistical basis (Jonsson, 2001; Needham, 2003; Hughes and Franks, 2004; Sacripanti, 2007b; Ruscello et al.; 2008b).

This line of research is also called "**Off-Line Analysis**".

9.5. The Games Theory applied to the Team Sports: forecasting the outcome of possible strategies through Data Mining and Artificial Intelligence

Data mining has become an innovative and powerful research tool in business for knowledge discovery and the development of predictive models from large volumes of historical data. Statistical techniques of data mining include linear and logistic regression, multivariate analysis, decision trees and neural networks. However, the application of data mining in physical education and sport is in its infancy. Data mining techniques can be used for predictive purposes in sports. One way to do this is to use machine learning, which covers a variety of solutions such as **decision trees**, **production rules**, and **neural networks**, to make predictions based on the hidden information within data (Chen et al, 1994). In their paper Expert Prediction, Symbolic Learning, and Neural Networks, Dr. Hsinchun Chen and his counterparts test the predictive capabilities of machine learning against those of human experts in greyhound racing.

The two-machine learning techniques used in the study are ID3, a decision-tree building algorithm, and back-propagation, a neural network-learning algorithm. An artificial neural network, to put it as simply as possible, is a non-linear data

modelling tool that can be used to find hidden patterns and relationships within data. The data set used revolved around information available to bettors consisting of each dog's historical performance records. Additionally, each race program contained information about each of the eight dogs competing such as their fastest time, total number of races, as well as the amount of first, second, third, and fourth place finishes. Also, the programs displayed a detailed view of the last seven races the dog had competed in. These listings showed the starting and finishing position of the dog and its position in the first (break), second, and third turn.

Finally, the dog's total race time and the grade of the race (indicating its competitiveness) are given.

Based on the opinions of regular bettors, track experts, and park management, the researchers chose the performance variables believed to be the most foretelling of future performance.

The resulting **ten attributes** recommended by the experts were:

- Fastest Time: The fastest time in seconds for a 5/16 mile race.
- Win Percentage: The number of first place finishes divided by the total number of races.
- Place Percentage: The number of second place finishes divided by the total number of races.
- Show Percentage: The number of third place finishes divided by the total number of races.
- Break Average: The average dog's position during the first turn for the seven most recent races.
- Finish Average: The average finishing position for the seven most recent races.
- Time 7 Average: The average finishing time for the seven most recent races.
- Time 3 Average: The average finishing time for the three most recent races.
- Grade Average: The average grade of the seven most recent races the dog competed in.
- Up Grade: Weight given to a dog when dropping down to less competitive racing grade.

To ensure that the algorithms could properly value the race grade attribute, each race type is assigned a weight. Races of grade A (the most competitive) down to

those of grade D (the least competitive) received values of four down to one respectively. Other races, such as those for training purposes, received a value of zero. Similarly, race times for each dog are relative to the other dogs competing in that race. Dogs in higher race grades will often have faster overall times than those in lower graded races. Hence, relative scaling of the race times was done by assigning the slowest time a value of zero and each other dog the difference between its time and the slowest time. For example, if the lowest time for the race was 32.00 seconds and another dog in the same race finished in 31.00 seconds then that dog would receive a value of 1.00.

For this study, the researchers used two-thirds of the total data – 200 races and 1600 greyhounds – for algorithm training purposes and the remaining one-third –100 new races and 800 greyhounds – in order to test the predictive capabilities of the algorithms.

The ID3 algorithm employed in the investigation used the attribute values, such as fastest time and others, to classify each greyhound as a winner or loser.

The predictions made by the algorithm were tested by comparing to those of the track experts. If an expert or the algorithm predicted a winner, $2.00 was wagered on that dog. If an algorithm predicted multiple winners, a bet was placed for each predicted winner. No bet was placed in the case that no prediction was made. The payoff odds given in the result sheets were used in order to calculate the total winnings of each expert in addition to the two algorithms. Only payoffs for first place finishes were considered.

The experts averaged 17 correct predictions and were incorrect in the remainingraces. Each of the three experts had a negative payoff at the end of all betting.

On the other hand, the ID3 and back propagation algorithms actually finished with significantly positive payoffs. ID3 in effect predicted double the amount of winners that were predicted by the experts while also avoiding betting on situations that were too close to call. The neural networks (back propagation) algorithm, on the other hand, while predicting less winners showed a propensity for correctly picking longshots – those dogs with the odds heavily against them.

Hence, the neural network approach saw nearly double the winnings of the ID3algorithm. Nonetheless, both algorithms radically outperformed the human experts by using data mining techniques in order to make predictions.

Another example of Data mining in Sport is provided in this thesis, in chapter 13, where the author performed a research employing a Data Mining software, in order to analyse the performance observed during the World Hockey Olympic Qualifier, women, held in Canada, in 2008.

Also **Artificial Intelligence** is gaining and increasing relevance in the world of Match Analysis, since it can provide manifold application to the finest problem involved in analysing the human performance.

Automatic marker-tracking systems allow more, and more accurate, human movement data to be collected. This could lead to the use of fuzzy Expert Systems for diagnosis of faults in sports techniques, a substantial development of the rudimentary Expert Systems currently embedded in some video analysis packages. Kohonen mapping will become commonplace in sports biomechanics, particularly if the technique elements captured by the mapping can be identified. Dynamically controlled networks will become more widely used in studying learning of movement patterns. Multi-layer ANNs will have an important role in technique analysis, a view supported by their use elsewhere in biomechanics, including the closely related domain of gait analysis.

Other Artificial Intelligence applications – particularly Evolutionary Computation and hybrid systems - will feature in future developments in the optimisation of sports techniques and skill learning. Finally, the links with dynamical systems theory will become even more apparent, leading, for example, to an enhanced understanding of movement coordination and the role of movement variability.

9.6. Real Time Match Analysis Methodologies

This aspect is deeply related to the future of Match Analysis. Indeed many coaches, researcher and scholars are looking for the aid that the new technologies may offer to the sport science in order to cope with the ever-increasing demands that modern team sports require. A particular issue, implying deep modifications of the "usual" attitude in Coaches and other referred professional profiles, is the Real Time Match Analysis, namely the procedure able to provide important information during an ongoing match and the possibility to intervene during the Match to modify some tactical behaviour, according to the observation just made.

Neural Networks seem to be an interesting resource offered to Sport Sciences by Information Technology, in order to let Real-Time Analysis.

Artificial neural networks are tools, which similar to natural neural networks can learn to recognize and classify patterns, and so can help to optimise context depending acting.

These abilities, which are very useful in a lot of technical approaches, seem to be as well useful in particular in analysing and planning tactical patterns in sport games or patterns of learning behaviour in training processes.

Jürgen Perl (2001), from the University of Mainz, Institute for Computer Science, carried out an interesting research on this field.

In a first attempt, in co-operation with LAMES from the University of Rostock, Tactical structures in volleyball could successfully be analysed using neural networks.

However, the problem is that the special type of network that has to be used for such analyses (i.e. the so called Kohonen Feature Map or KFM) needs a huge amount of data and lacks the necessary dynamic in continuous learning.

So in order to describe, analyse, and evaluate continuous learning processes in sports a dynamically controlled network ("DYCON") has been developed, which consists of a conventional KFM combined with a time-independent neurone-driven control: each neurone is imbedded in a dynamic performance potential control system, which had been developed for analysis and control of physiological adaptation processes in sport.

Two main advantages of DYCON were: its learning efficiency was very high. In practice, it needed only some hundred data to coin a pattern, where a conventional KFM normally needs about 10.000 to 20.000. Moreover, it was able to learn continuously and so was able to recognise and analyse time depending pattern changes.

So, DYCON was able to support the study of processes in sport games in an easier and more efficient way. Moreover, it was able to help to analyse tactical changes of a team during a season or even during a tournament, as has been done with squash in co-operation with Mc Garry, University of Fredericton.

9.7. Introduction to the Specific Training and Coaching Methods

Strategy and Tactic are very often almost neglected in training sessions, mostly in youth sports (Wein, 1993, 1999).

Team sports tactics, which are fundamental in these sports, often are trained only by the "Trial and Error" system, instead of using a progressive and planned method of training.

The implications of Specific Training and Coaching Methods concerning the Tactic aspects are not a core part of this thesis, but it seemed anyway important to provide a global overview and specific recommendations referring to this issue, suitable to inform the match analyst while operating.

1. Tactical preparation must be planned together with the Technical one, since the technical skills heavily influence the performance, together with the fitness level.

2. Tactical behaviour has to be trained by gradually increasing the coordinative level of the motor demands.

3. First one should learn the basics of the Tactic behaviour (specific for each sports or athletic disciplines) and after that one might face the variations and the alternatives.

4. The level of the player's observational skills (central and peripheral vision) heavily influences the tactic skills and related behaviours. A specific training is required. This involves specific sport pedagogy, based on the providing the correct feedbacks, both in terms of quantity and quality (Hughes and Franks, 2004).

5. Tactic Mastery is achieved when the player is able to perform the required skill in every condition, no matter how difficult or adverse (Meinel, 1984).

9.8. Quantitative-qualitative Match Analysis in Football: Strategy and Tactic

(By Andrea Ciuffarella and Bruno Ruscello, 2008)

In situation sports Match-Analysis has the task of providing information on single elements of individual and/or collective performance (Hughes and Franks, 2004; Carling et al., 2005; Sacripanti 2007a e 2007b). The technical-tactical-strategic

analysis of this study is aimed at highlighting a performance model to describe the individual interpretation of a role, within the playing flow, determined by the tactical-strategic module adopted. From a methodological point of view a simple proposal is put forward - event recording – (Darst et al., 1983), designed to be easily repeated in field situations thanks to its application, even with the use of non-sophisticated instruments. The performance of a footballer - a central defender or Centre Back - was analysed, in quantitative and qualitative terms, during a whole match, in order to draw up a technical, tactical and strategic model of performance for top level men's football, in order to be able to produce an optimal individual profile for a central defender in a top level team. The study was conducted in the period January-May 2007, with the observation of sixteen matches of two Italian Serie A teams (A.S. Roma, six matches, and S.S. Lazio, ten matches) and of the players playing as central defender, on both the right and left side. The Authors themselves effected the filming for the study. Relative data processing and analyses did not show up statistically significant differences among the players playing this role in terms of the playmaking, although some individual tactical-strategic interpretations were observed that led a different qualitative evaluation in some cases in which the response appeared to show the degree of attacking intent of the player.

9.8.1. Materials

In this case study the authors videotaped 16 matches of the "Serie A", that is the major Italian Football League (A.S. Roma six matches, S.S. Lazio ten matches). The matches were taped in the period January-May 2007 using a digital camera JVC GR-D239 (optical zoom 25x, digital zoom 800x). The generated video files were transferred by a fire-wire link to a laptop and then processed by some software provided directly by the implemented OS (Windows MovieMaker and Windows Media Player). The relevant statistical analysis was performed, using a Microsoft Excel spreadsheet and the SPSS 14.0.

All the video tapings were aimed at recording the tactical behaviours of just one player at the time, playing the selected and observed role (the defensive centre-back), independently from the ball movements.

All the passes performed by these players were classified, referring to their tactical meanings, according to a system designed by the authors and reported in table 1)

Type of passing	Accorded value	Using the "wrong foot"
Passing back to the goalie	0	+1
Passing to a close mate (< 10 m.)	1	+1
Direct Passing to a mate ahead (10-20 m.)	2	+1
Long passing to a mate on the right	3 R	+1
Long passing to a mate on the left	3 L	+1
Direct Passing into the opponent's defensive zone.	4	+1

Table 3 – Accorded values referred to the Tactical Meaning of the passing. A Technical value (using the "wrong foot") is also added.

9.8.2. The research rationale

This study is aimed at systematically observing and describing some sport events occurring on the field, according to observational categories conveniently designed by the authors.

Those categories were designed in order to provide possible answers to these research's questions:

1. How the Defensive Centre-Back plays the ball?
2. To whom the Defensive Centre-Back prevalently passes the ball?
3. How he moves on the field while performing the match?
4. When does he support his team play in attack?
5. What are his tactical behaviours as a defender?
6. What is the variability in this role? In other terms what is the degree of freedom of a player playing a specified role in a specified system of play?
7. What are the differences between a Centre Back playing on the right or on the left, in a 4:4:2 system?

9.8.3. Methods

The Video Analysis investigated both the Quantitative and Qualitative dimensions of the performance. Processed data provided information both in terms of Event Recording means and totals (quantitative analysis) and in terms of percentage of success (quanti-qualitative and qualitative analysis).

In order to make the relevant comparisons among the different observed players, we normalized the obtained absolute frequencies to the effective time of play performed

by each individual player during a Match, and express them in term of Rate per Minute (RPM).

9.8.4. Results

All the relevant statistics are provided in the reported Tables below.

Right Centre Back

On the Tactical side we can highlight that, playing as a **right central defender**, only one player showed a success value in aerial play greater than 70%. (Player G.S. – Table 2), whereas the other players showed an efficacy ranging between 62-67%. It is noteworthy that the opponents in aerial plays more than 25% have anticipated players G.S. and L.Z., whilst the other players achieved values around 10%.

Aerial Plays (A.P.)	S.S. (291 min.)		M.F. (285 min.)		G.S. (95 min.)		L.Z. (53 min.)	
	N	%	N	%	N	%	N	%
Positive A.P.	28	63.64	36	66.67	5	**71.43**	5	62.50
Negative or Wrong A.P.	12	27.27	12	22.22	0	0.00	1	12.50
Player being anticipated by the opponent	4	**9.09**	6	**11.11**	2	28.57	2	25.00
Total A.P.	**44**	**100.00**	**54**	**100.00**	**7**	**100.00**	**8**	**100.00**

Table 4 – Success Rate in Aerial Play – Right Centre Defender

In Table 3) the normalized values per minute (Rate per Minute, RPM) we observed about some specific tactical behaviours are provided. We noted that the ability to anticipate the opponents has been performed with a RPM ranging from 0.070 and 0,075 in three players. The "Defensive Diagonal" was performed almost every minute in quite all the players (only L.Z. showed a significant difference).

Tactical Behaviours	S.S. (291 min.)		M.F. (285 min.)		G.S. (95 min.)		L.Z. (53 min.)	
	N	RPM	N	RPM	N	RPM	N	RPM
Anticipating the opponent	15	0.052	20	**0.070**	7	**0.074**	4	**0.075**
Performing the Defensive Diagonal	270	**0.928**	279	**0.979**	105	**1.105**	40	0.075
Clearing the defensive area, moving with the ball	11	0.038	12	0.042	3	0.032	0	0
Come through the mid-line, off the ball	101	0.347	123	0.432	10	0.105	12	0.226
Supporting the attacking play		0.155	29	0.102	5	0.053	0	0

Table 5 – Right Centre Defender – RPM values about some tactical behaviours.

In table 4) we presented some statistics about the attacking phase performed by these players. Most of their involvements during these phases are connected to the Corners or Free Kicks situations, close to the penalty area. Player M.F. showed the higher value with a 69% on Corners and a 24% on other situations.

Attacking Behaviours	S.S. (291 min.)		M.F. (285 min.)		G.S. (95 min.)		L.Z. (53 min.)	
Come through the mid-line, off the ball	N = 101		N = 123		N = 10		N = 12	
	N	%	N	%	N	%	N	%
Supporting the attacking play:	45	44.55	29	23.58	5	50.00	0	0.00
• Corners	24	53.33	20	68.97	0	0.00	0	0.00
• Free Kicks	15	33.33	2	06.90	3	60.00	0	0.00
• Other	6	13.33	7	24.14	2	40.00	0	0.00
Total	45	100.00	29	100.00	5	100.00	0	0.00

Table 6 – Right Centre Defender : Percentage Values in attacking support.

In table 5) passing behaviours are analysed. Each player achieve positive percentages higher than 70% with two of them reaching an impressive 80%.

We noted that these players relied most on short passes (the safest) instead of looking for long or "direct pass" to the attacking zone. Player L.Z. showed the lowest positive percentage and, consequently, the highest negative percentage (22%).

Passing Behavior	S.S. (291 min.)		M.F. (285 min.)		G.S. (95 min.)		L.Z. (53 min.)	
	N	%	N	%	N	%	N	%
Positive Passing	134	84.28	158	85.87	42	77.78	19	70.37
Negative Passing	22	13.84	18	9.78	7	12.96	6	22.22
Long Passing	1	0.63	5	2.72	2	3.70	1	3.70
Bad Passing from poor technique	2	1.26	3	1.63	3	5.56	1	3.70
Total passing	159	100.00	184	100.00	54	100.00	27	100.00

Table 7 - Right Centre Defender: Passing Percentages

Left Centre Back

We analysed the tactical behaviours of the players acting as Left Centre Back, accordingly to what we did for their colleagues playing on the right side. In aerial play (Table 6) we can note that the observed values are similar to those found on the right players (Table 2), ranging from 64% to 74% of positive interventions.

Aerial Plays (A.P.)	E.C. (247 min.)		S.S. (210 min.)		P.M. (190 min.)		C.C. (72 min.)	
	N	%	N	%	N	%	N	%
Positive A.P.	23	63.89	26	66.67	17	73.91	2	66.67
Negative or Wrong A.P.	4	11.11	7	17.95	5	21.74	1	33.33
Player being anticipated by the opponent	9	25.00	6	15.38	1	4.35	0	0.00
Total A.P.	36	100.00	39	100.00	23	100.00	3	100.00

Table 8 - Success Rate in Aerial Play – Left Centre Defender

In Table 7) we analysed some tactical behaviours of the players, as we did previously and reported in table 3). The RPM values are provided. We can note that the Defensive Diagonal has been performed almost once a minute, as it happened also in the right players, excluding player C.C., presenting lower values.

The other observed values (anticipation, clearing the defensive area with the ball, coming through the mid-line with the ball or supporting the attacking phase) substantially matched the ones found for the right players.

Tactical Behavior	E.C. (247 min.)		S.S. (210 min.)		P.M. (190 min.)		C.C. (72 min.)	
	N	RPM	N	RPM	N	RPM	N	RPM
Anticipating the opponent	20	0.081	10	0.048	12	0.063	3	0.042
Performing the Defensive Diagonal	172	0.899	198	0.943	168	0.884	52	0.722
Clearing the defensive area, moving with the ball	4	0.016	5	0.024	7	0.037	3	0.042
Coming through the mid-line, off the ball	57	0.231	76	0.362	63	0.332	24	0.333
Supporting the attacking play	21	0.085	35	0.167	17	0.089	1	0.014

Table 9 – Left Centre Defender – RPM values about some tactical behaviour

As it occurred in right players, also the left centre backs participated to the attacking phase of their own team during Corner or Free Kicks close to the penalty area.

A clear relationship between the ability showed in Aerial Play and the participation in Corner and/or Free Kicks is here confirmed (Table 8).

Attacking Behavior	E.C. (247 min.)		S.S. (210 min.)		P.M. (190 min.)		C.C. (72 min.)	
Come through the mid-line, off the ball	N = 57		N = 76		N = 63		N = 24	
	N	%	N	%	N	%	N	%
Supporting the attacking play:	21	38.64	35	46.05	17	26.98	1	4.17
• during Corners	10	47.62	18	51.43	7	41.18	0	0.00
• during Free Kicks	9	42.86	14	40.00	4	23.53	0	0.00
• Other	2	9.52	3	8.57	6	35.29	0	0.00
Total	21	100.00	35	100.00	17	100.00	1	0.00

Table 10 - Left Centre Defender : Percentage Values in attacking support.

In table 9) passing behaviours are analyzed. Each player achieve positive percentages higher than 80% with one of them reaching an impressive 91%.

Player C.C. achieve also a very good result performing no ***Negative or Wrong Passing***. Values of long or direct passing are about 5% in all the players.

Passing Behavior	E.C. (247 min.)		S.S. (210 min.)		P.M. (190 min.)		C.C. (72 min.)	
	N	%	N	%	N	%	N	%
Positive Passing	112	82.35	67	80.72	57	82.61	22	91.67
Negative Passing	9	6.62	9	10.84	7	10.14	0	0.00
8Long Passing	7	5.15	5	6.02	4	5.80	0	0.00
Bad Passing from poor technique	8	5.88	2	2.41	1	1.45	2	8.33
Total passing	**136**	**100**	**83**	**100**	**69**	**100**	**24**	**100**

Table 11 - Left Centre Defender: Passing Percentages

In building-up situations we found some differences among the players performing as Centre-Backs.

The **individual sociograms** of passing and building up are provided, with the dimension of arrows representing quantitatively the amount of passes performed by each player to the other team-mates (Figure 1-8).

Despite some individual differences observed, a similar percentage has been found in the kind of passes made toward the different units forming a team (the defensive unit, the midfield and the attacking unit), characterizing the type of play showed by the two different teams (Figure 9 and 10).

The **general strategy** adopted by A.S. Roma, and analyzed and described by our research, showed a **pattern of building-up** that mostly relies upon passing between the defensive unit and the midfielders (Figure 9), whereas S.S. Lazio's strategy seems to be more aimed at maneuvering the ball within the defensive unit (figure 10).

These data made us understand the different ways the two teams used to play. A.S. Roma's central defenders preferred to pass the ball to the central midfielder, who came back for the pass in order to build-up the play later on.

S.S. Lazio's central defenders used to play the ball preferably to the other defensive team mates, in order to change the direction of the attacks.

We analysed the performances as **Right Centre Back** of M.F. of A.S. Roma (Figure1)
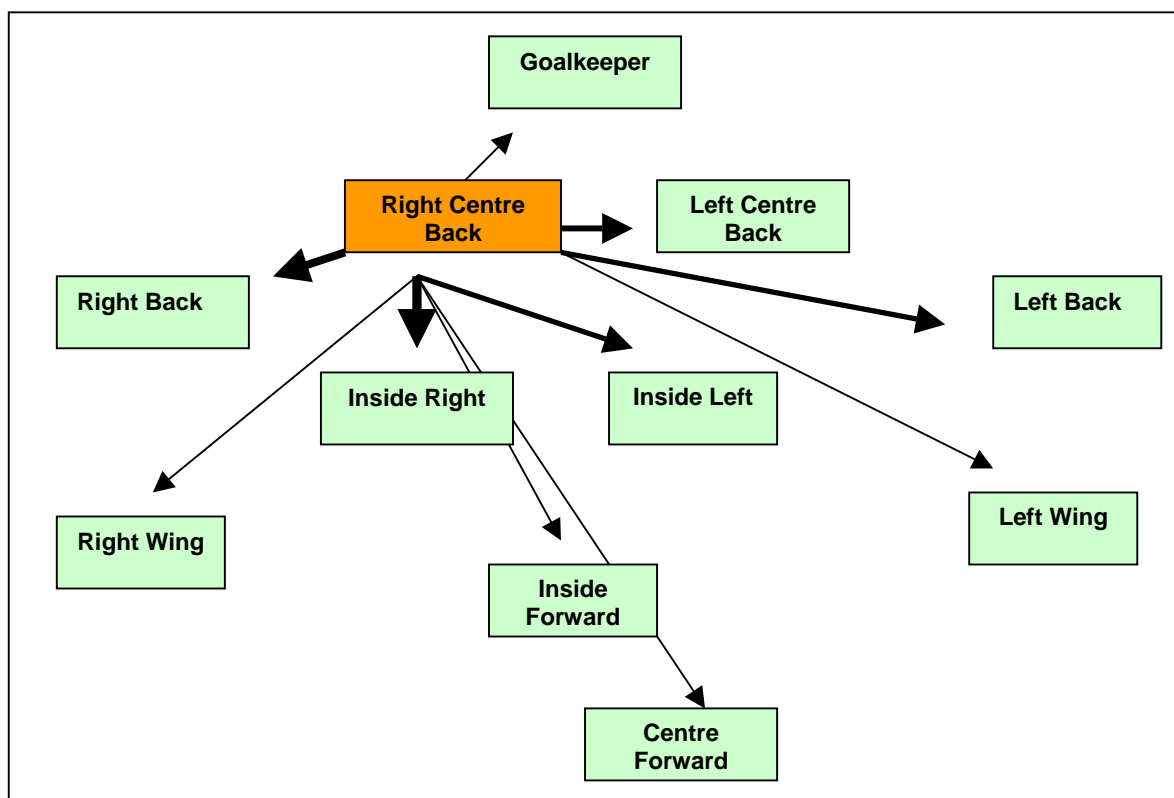
Figure 1 – M.F. – A.S. Roma

He passed the ball frequently to the insides players, who came back to receive, mostly to the Inside Right. He also looked for the Right Back, with short and safe passes, with no risks, while he almost never looked for long or direct passes to the attackers.

We analysed the performances as **Left Centre Backs** of P.M and C.C. of A.S. Roma (Figure2 and 3).
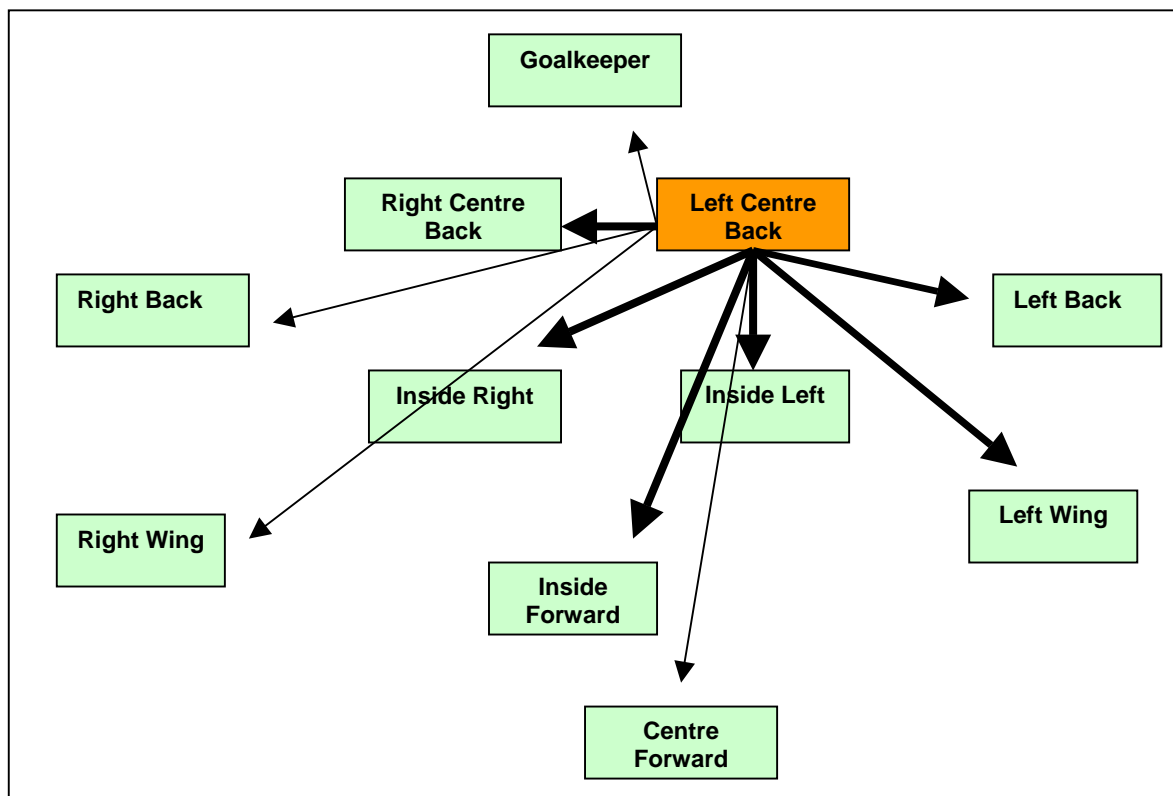
Figure 2 – P.M. – A.S. Roma

Player P.M. (figure 2) played many passes to the Right Centre Back and to the Left Back, while playing with his defence mates; he also made a number of passes to the Inside Left, the Inside Right and the Left Wing. This player showed a certain ability to vary his style of play, not allowing his opponents to easily predict what will be the next move.

Player C.C. (figure 3) interacted very much with his midfielders, particularly with the Inside Left, with passes of Type 1 (see Table 1). It is also interesting that C.C. often changed the direction of the attack, passing the ball to the farthest Back (the Right Back in this case). This meant that C.C. tried to "jump a man" of his defence (the other centre back) in order to speed up the game with a sudden change of direction, using a pass of type 3 (again, see Table 1). The good technique needed to perform positively these type of passes is witnessed by the data collected about C.C.'s performance (see Table 9).
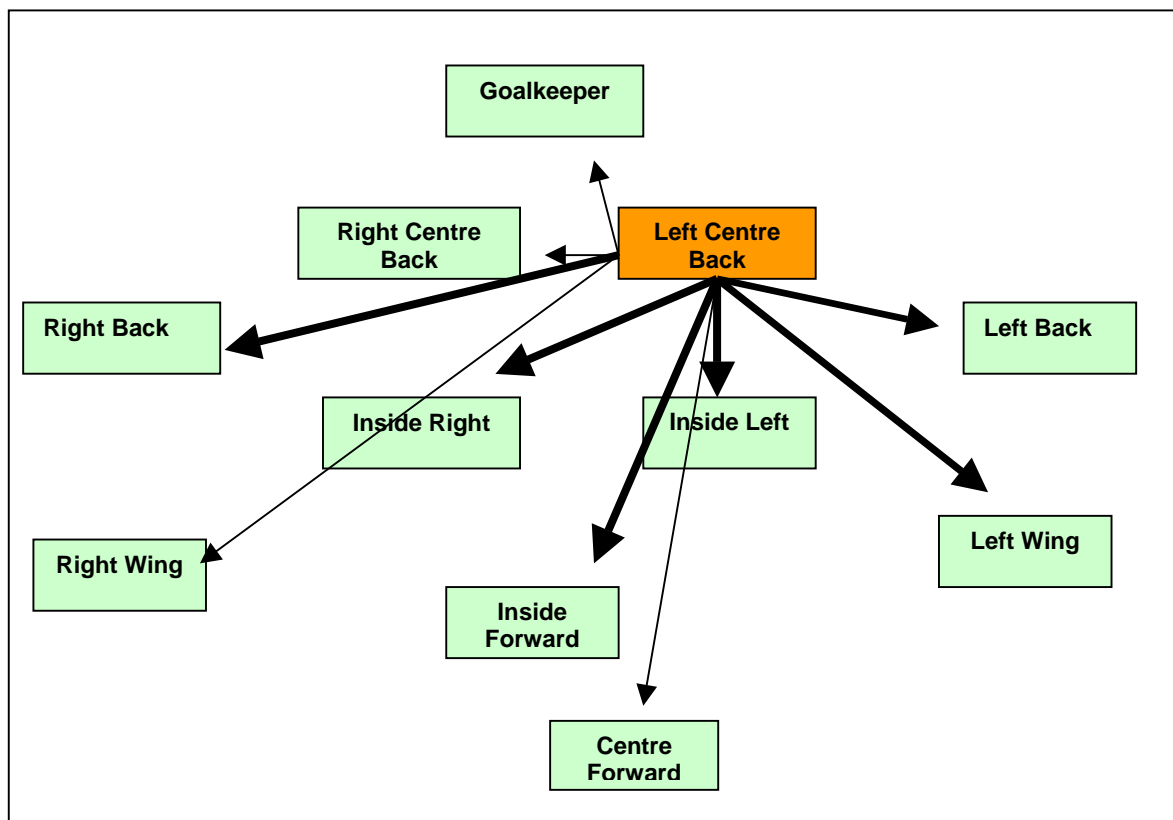
Figure 3 – C.C. – A.S. Roma

We analysed as **Right Centre Backs** for S.S. Lazio, the players S.S. (figure 4), G.S. (figure 5) and L.Z. (figure 6).

Player S.S. performed many short passes (Type 1) to the Central Midfielder and to the other two defenders closer to him. We can also note that he passed the ball practically to all the team mates, performing long passes and once, executing a Type 4 pass, that created a goal change for his attacker.

Player G.S. (figure 5) played many passes to the closer defenders and, in 15% of the cases, he played back to the goalkeeper. Probably the **strategic** reason why he played so many back passes to the Goalkeeper was the fact that Lazio was winning the match by two goals and the coach might have instructed his defending players to relieve the opponents' pressure by playing back to the goalie, in order to use a subsequent long pass.
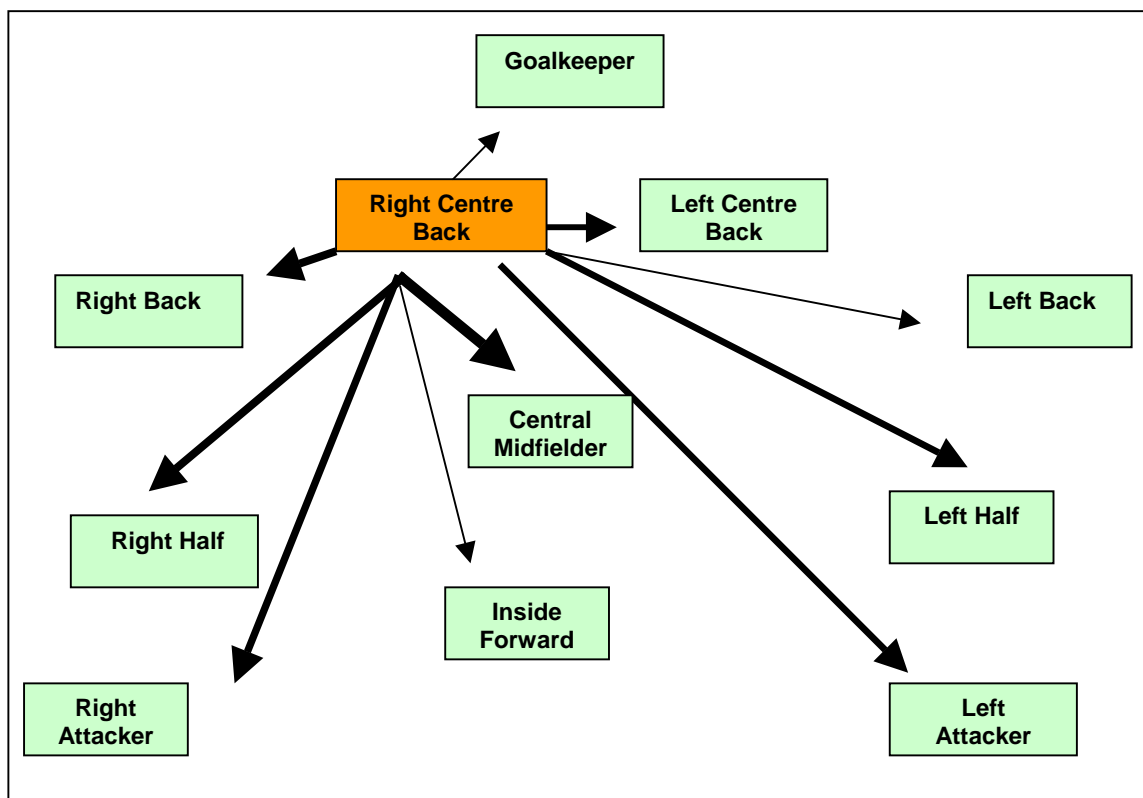
Figure 4 – S.S – S. S. Lazio
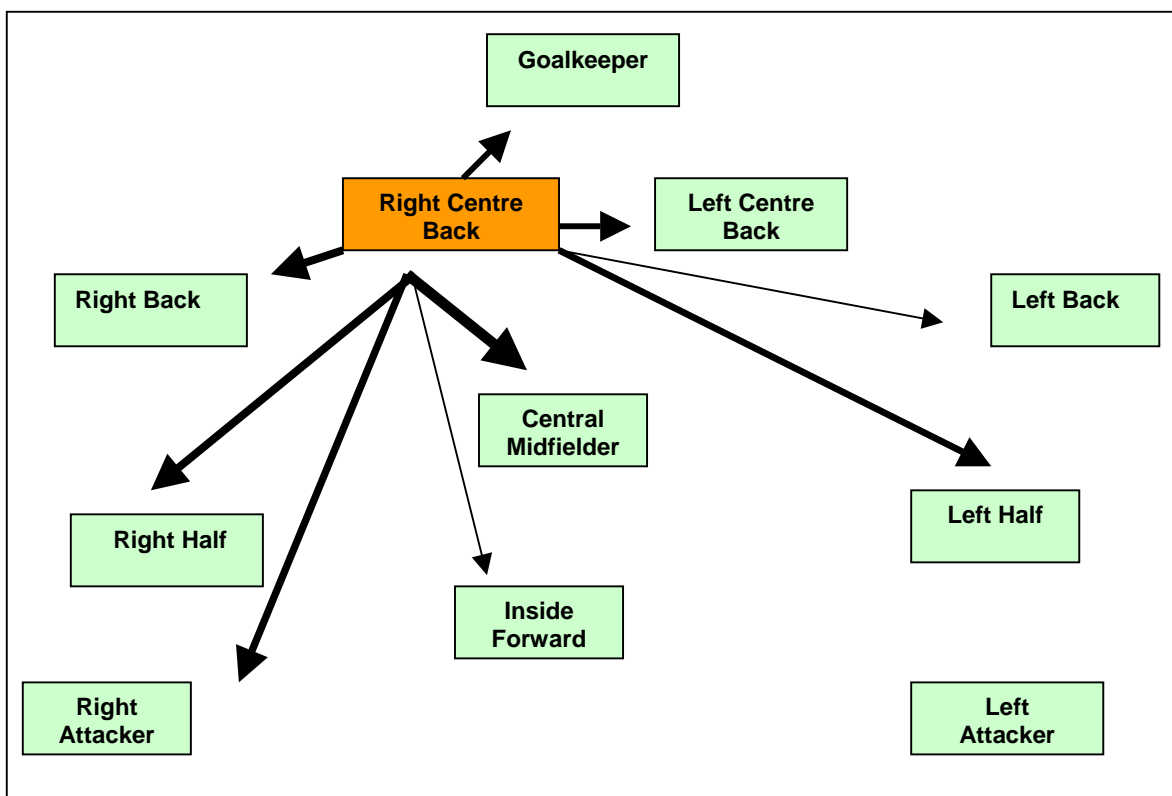
Figure 5 – G.S. – S. S. Lazio

Player L.Z. made no big differences from his team mates, previously analysed. Nevertheless we can highlight the ability he showed in certain situations where he made long passes directly to the farthest Left Half, so changing direction of attack in a clever way.
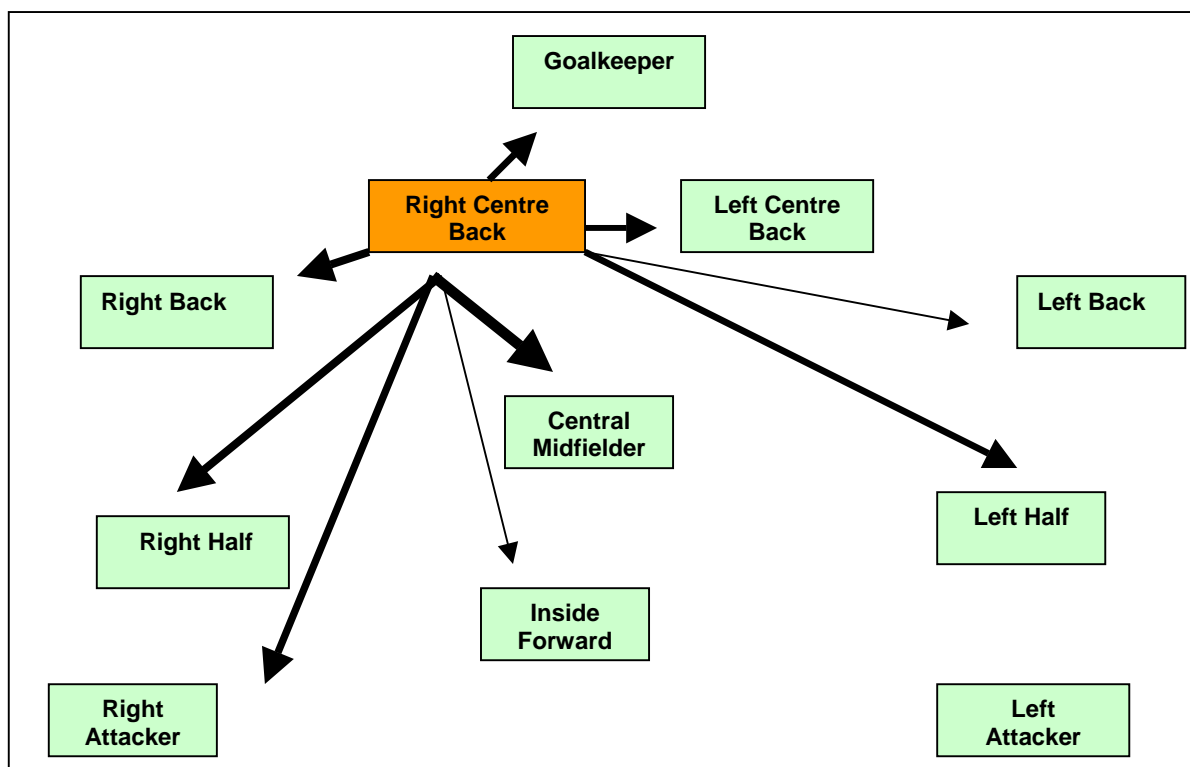
Figure 6 – L.Z. – S.S. Lazio

We then analysed the performances of the S.S. Lazio's players, acting as Left Centre Backs: E.C.(figure 7) and S.S. (figure 8).

Player E.C., playing for 247 minutes, passed the ball prevalently to his defence mates, preferably to his Left Back. Confirming his preference of playing on the left side of the field, we can note that he played more with the left half than the centre midfielder, as occurred with the other Left Centre Backs employed by Lazio. He confirmed the almost general trend to play short passes (Type 1), in a safer way, in order to avoid any risk of loosing possession.
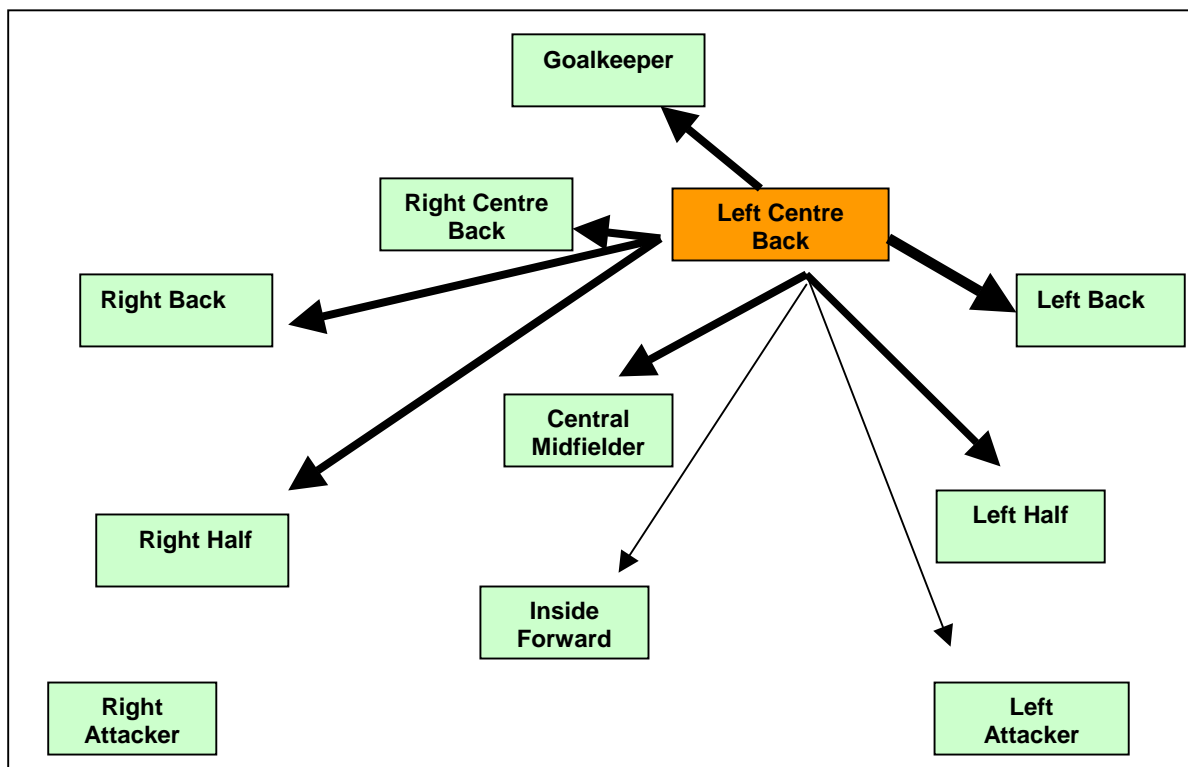
Figure 7 - E.C. – S.S. Lazio

Player S.S. (figure 8) also relied more on short and safe passes, (Type 1), preferably on the Left Back. He also tried to use direct pass to the attacking zone, looking for sudden acceleration of the game inside the opponent's area. He achieved some good result in doing so, since he was able to "assist" an attacker with a good pass who created a goal opportunity.

He played also as Right Centre Back (see figure 4) but no significant differences may be found in his performance while playing these two different roles.
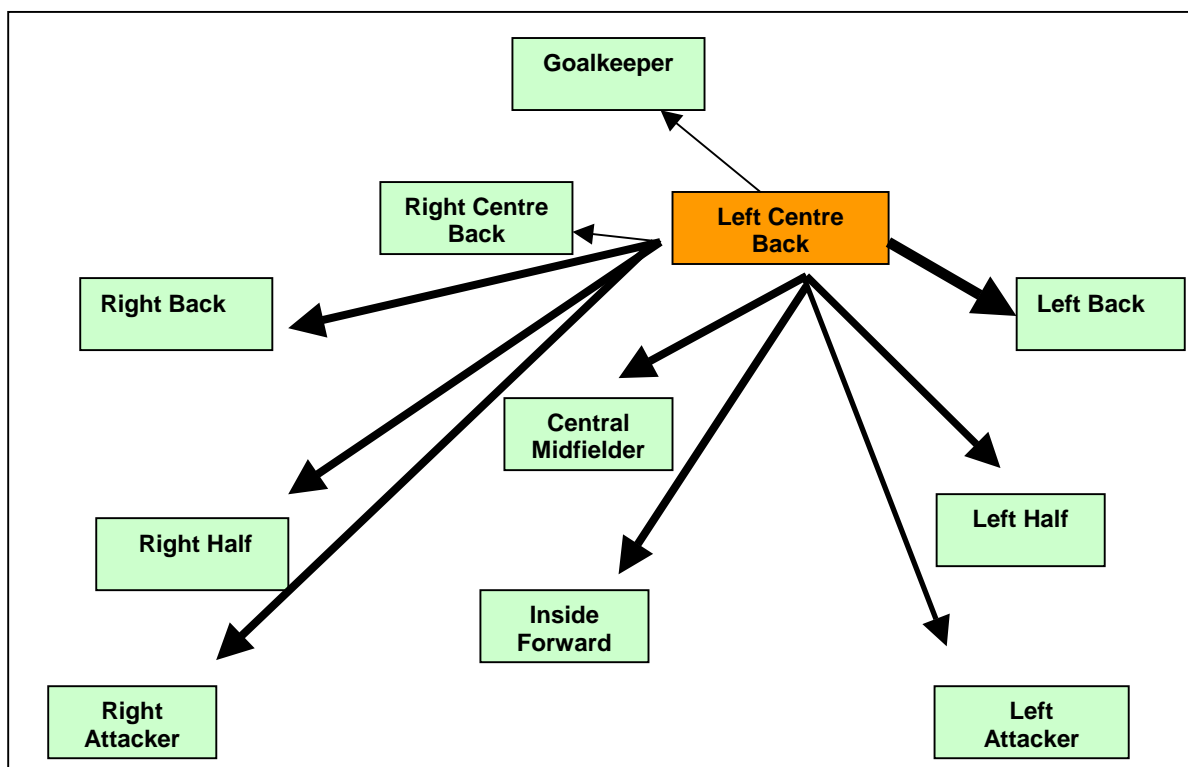
Figure 8 – S.S. – S.S. Lazio

Analysing the whole performance of the two defending units (Roma and Lazio) referring to their Passing Behaviour, we can outline that the two teams adopted a different **General Strategy** in their building up routines, as showed in figure 9 and 10. A.S. Roma seemed to rely more on the initial building-up of the game through a more frequent participation of their midfielders (50% vs. 42% of S.S. Lazio), whilst S.S. Lazio relied on a strategy based on the initial ball circulation within the defending unit, probably looking for sudden change of direction, attacking from the wings.
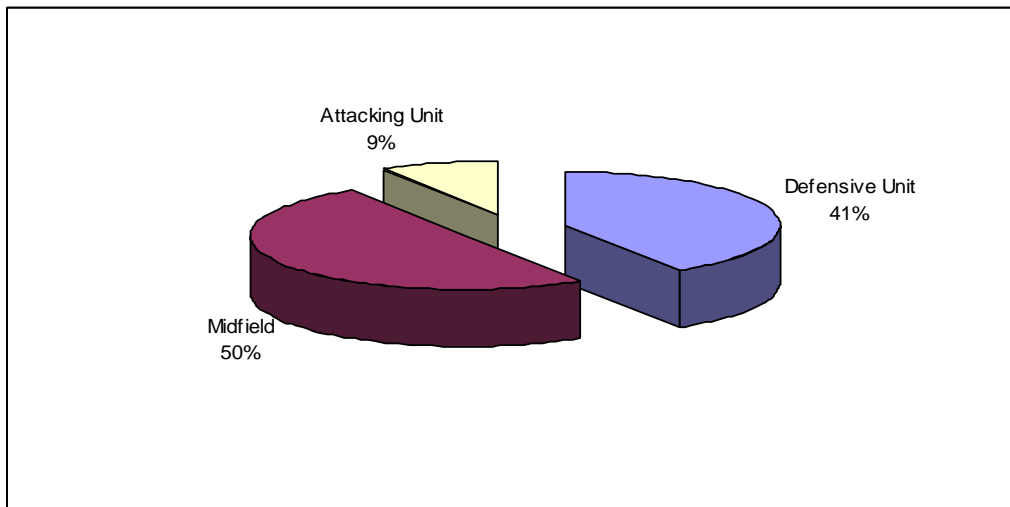
Figure 9 – Percentage of passes performed by the Centre Backs to the different team units - A.S. Roma
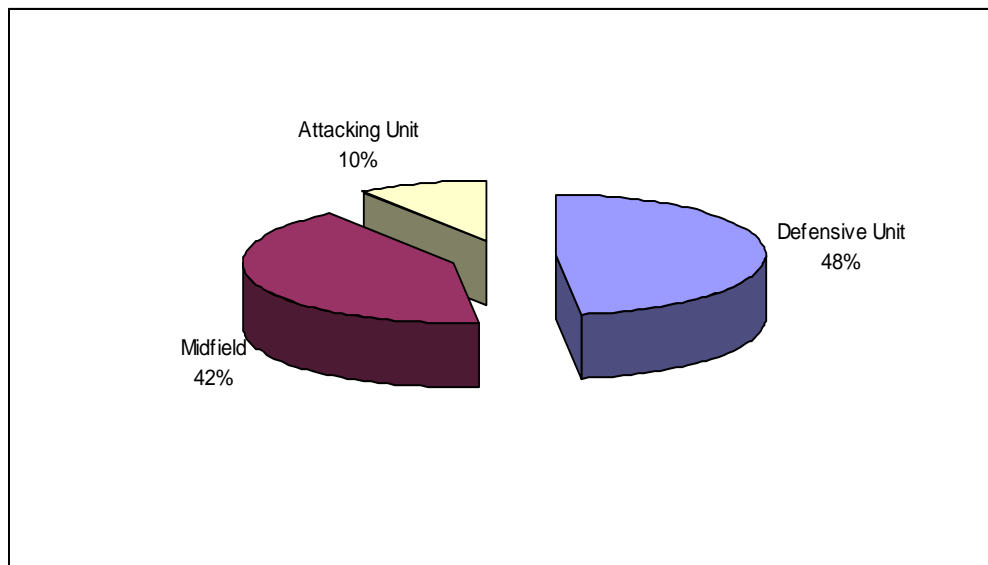
Figure 10– Percentage of passes performed by the Centre Backs to the different team units - S.S. Lazio

9.8.5. Discussion

The collected information and the processed data allowed us to answer the initial research's questions, regarding the **strategic and tactical behavior** of a Centre Back playing in a Football Top Team, thus providing this **strategical and tactical performance profile** :

1. He usually plays the ball **passing to a closer mate** (short passes, type 1). In A.S. Roma he prefers to play with a midfielder coming back to receive, whereas in S.S. Lazio he prefers to play again short passes with the other defending mates, in order to find sudden accelerations down the side of the field (changing direction of play/attack);

2. He moves on the field, **performing more sprints[1] towards his own goal** than the opponent's one. That is probably linked to the "short team" style applied in both the teams (and, generally, in all football top teams), where is much more frequent to sprint toward his own goal, in order to close down the opponents. He performs a **Defensive Diagonal** (see figure 11) almost once a minute, but this data needs more investigation to be confirmed.

Figure 11 – Performing a Defensive Diagonal (white team)

3. He **participates to the attacking phase** of his own team mostly in **Corners** and in **Free Kicks** close to the opponents' penalty area. That is probably because a Centre Back has to be really effective in aerial play (as it is shown in Table 2 and in Table 6) both for creating more chance to deflect the ball to the goal or to **tactically participate** in crowded situation inside the penalty area, in order to shadow or block the opponent and free a mate for a goal shot.

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[1] The relevance of the Repeated Sprint Ability has been already discussed in chapter 7

4. In the defensive phase, the Centre Back showed a good **ability in anticipate the opponent** (that implies a great ability in reading the game: he must be pro-active rather than reactive). In tackling the ball he usually **does not commit fault** (because of the dangerous field position he usually plays on). This aspect seems to be related to the so-called strategy "tactic fault", performed mainly by the midfielders far from the very dangerous area close to the goal.

5. Again we emphasize the **relevance of Aerial Play** in this role, since modern football is heavily influenced by the fitness and power components of the player. Being anticipated while performing this role could be really dangerous, as it happened to player M.F. of A.S. Roma, when they played Udinese Calcio.

9.8.6. Conclusion

As previously stated in this thesis, Match Analysis has got manifold aims (Reilly et al., 1993; Reilly et al., 1997; Carling et al., 2005; Ruscello, 2008a; Sacripanti, 2007a) and one must be careful in selecting the proper information suitable to help consistently the work of the coaches in the overall training process.

This case study purposely tried to provide a form of Match Analysis, scientifically correct, obtained through a low-cost technology, that is not expensive devices (a laptop and a video camera) and ordinary software, available with the most used Operative System (OS) and even with open source software, downloadable from the net for free.

As stated in Chapter 11 of this thesis, the Match Analyst's professional profile is gaining relevance day by day, and the example reported by this study could be a first attempt to qualify this role within the sport world.

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248

Chapter 10

Methodology of Observation and Evaluation Processes

"One hundred rumors are not comparable to one look."
Old Chinese proverb

This chapter provides a short introduction of systematic observation, including its definition, purpose, limitations, and overall process. Match Analysis is about collecting and analyzing data, namely observing matches according to a specified observational plan, that is a systematic observation (Pieron, 1989; Madella et al., 1994; Sacripanti, 2007a, 2007b). Darst, Mancini, and Zakrajsek (1983) stated that *"systematic observation allows a trained person following stated guidelines and procedures to observe, record, and analyze interactions with the assurance that others viewing the same sequence of events would agree with his [or her] recorded data"*. As the definition indicates, systematic observation involves both **observing and recording**. Both differ in their respective purposes. Johnston and Pennypacker (1980-1993) noted that "the goal of observation is to arrange conditions so that man or machine will react sensitively to the defined dimensions of the subject's behavior". The recording act aims to produce an accurate and permanent account of the observation for future examination (Ruscello, 2008a). Both acts can be performed by humans and/or machines, such as audiorecorders, videorecorders or computers.

10.1 Systematic Observation

Systematic observation has enjoyed large popularity in such areas as anthropology, social psychology, clinical psychology, and cross-cultural psychology, over the last four decades. Thus it is not a new or revolutionary phenomenon. However, systematic observation become an important investigative procedure (i.e in the study of classroom teaching efficacy) only in the 1960s.

The emergence of systematic observation in the realm of teaching or of sport training is closely related to the advances made in teaching research methodologies (Donati et al.;1994; Haag, 1994).

 The search for personality traits and effective teaching methods proved fruitless from the 1930s until the mid-1950s, largely because nobody bothered to actually go into regular classrooms and see what was going on.

Broadly construed, observational analysis covers any systematic attempt to watch something's behavior and describe what it does.

10.1.1. Traditional Methods of Data Collection

Systematic observation continues to compete with other more traditional methods of gathering information on what coaches and their athletes do during a match.
These include:

1. **Eyeballing**
2. **Anecdotal recording**
3. developing **Rating Scales**
4. using **Check Lists**.

Each of these techniques has played (and it continues to play, for sure, also on the present days…) a major part of the evaluation of the sport events.

Eyeballing

Eyeballing refers to the situation in which an outsider (usually a Technical Director, a Match Analyst or an Assistant Coach) enters the sport setting and looks at the ongoing activities without making any formal written record of what is seen. Based on the memory of what was seen, the Analyst may provide feedback to the Head Coach. Eyeballing is used in not only visits to the training or competing sessions (i.e. friendly matches) for evaluation purposes, but also other settings to monitor how coaches and players conduct themselves in all aspects of their jobs. Of course this kind of Analysis is no way a scientific one, but probably the most used even in these present days in the vast majority of sport settings.

We underline that, according to our experience, many important operative decisions are made upon the "data" collected through this mean of analysis, even in top sport world (Kormelink, H.; Seeverens T.; 1999).

Anecdotal recording

Anecdotal recording is very similar to eyeballing, with the only difference being that the observer now writes down some of the things that he or she sees and hears. Other labels for this strategy are **narrative recording** and **informal analysis**.

Rating Scales and Checklists

Both **Rating Scales** and **Checklists** are quite popular in the process of Sports' Performance evaluations. In using rating scales, the observer is asked to give his or her opinion on various aspects of the ongoing performance-match. When checklists are used the observer merely marks whether certain things were said or were attended to by the players, again based on his or opinion.

For example, a question might ask *"Did the player A use square passes more than direct play?".*

10.1.2 Limitations of Traditional Data Collection Methods

The limitations of the traditional techniques lie in their lack of **objectivity, reliability and specificity** (Madella A; (2007).

First, the resulting data are primarily reflections of the observer's opinions about certain events that were seen. Johnston and Pennypacker (1980), Siedentop (1983) and Franks and Hughes (2004) noted that human beings are notorious for being poor observers. Opinions are based on the observer's personal biases and history of experiences. Thus there is a strong tendency on the part of the observer to report on aspects that he or she thinks are important. As a result, he or she might rate the performance of a certain player as low on, for example, a particular role interpretation, often requested by the Coach for strategic reasons, not because it did not work as well as it could have, but because the observer simply did not like that approach to organization in itself. Consequently, the resulting record reflects what he or she wanted to see, rather than what actually happened; Thus Rating Scales lack objectivity.

Second, although rating scales *look* scientific, there is no way to determine:

(a) exactly why one person scored a 3 and another person, viewing the same events, scored a 4;

(b) and (b) what the exact difference is between 3 and 4 and whether that difference is equal to the one between 4 and 5.

This problem becomes more profound as the scale widens from a 2-point scale to maybe a 5- or 7-point scale.

Furthermore, asking two or three independent observers to evaluate a Match using anecdotal recording most often produces three different narrative records. This, too, is most likely the result of each observer's personal bias in looking for some aspects and not for others (Hughes, 2004).

Taken one step further, if one of those three observers were to look at that same match again, he or she would most likely produce a different anecdotal record the second time around.

The data collected through anecdotal recording most often lack reliability.

It should be noted here that rating scales are not inappropriate in and of themselves, as long as they are used only to obtain a measure of opinion. However, their use as measuring instruments in the process of evaluating coaching and sport performances is highly suspect.

A third problem with the traditional observation methods is their lack of **specificity**. The information provided through rating scales and/or anecdotal recording cannot provide a specific data base on which recommendations for improvement can be made. Furthermore, subsequent improvement cannot be verified. Rating scales and checklists are simply too crude in showing that an improvement was actually made and measuring its extent. The point of identifying these limitations is to stress that the traditional methods are inherently unreliable ways of collecting data within the context of analyzing and evaluating teaching performance, primarily because there are no strict rules and procedures to follow.

10.2. *Primary functions and limitations of Systematic Observation*

Systematic observation (also called descriptive-analytic) is not reliable by definition just because it does have specific coding rules and procedures.

There are many sources that influence the observer's ability to observe reliably even with systematic observation tools. However, the use of those strict rules and procedures makes it possible to exert greater control over these sources.

Systematic observation tools play a major role in two different but related fields. Within these fields are various ways in which those functions are fulfilled. As part of research projects, systematic observation provides information on both independent and dependent variables (see chapter 13).

For example, much of the research aimed at changing playing behaviours used feedback as part of the intervention, and this feedback was typically based on data collected through systematic observation. Verification of **behavior changes** as a result of these interventions and the relevant training process (Weineck, 2001), was also established through such data collection procedures (Reilly et al.; 1993; Reilly et al.; 1997).

The second field into which systematic observation has made its entry is the ***supervision process***.

Supervision can serve a variety of purposes. It plays a major a role in:

(a) administrative decisions in sport settings (Club, National Teams), regarding the retention of coaches/players;

(b) staff/players development programs aimed at improving performance effectiveness;

(c) "cooperative effort" among coaches to guide new, inexperienced players during their first experiences by a new Club/National Team.

Systematic Observation does have some crucial limitations. First and foremost, it concentrates only on observable events and behaviors; that is, only those events that can be detected visually are measuredc (Sotgiu, Pellegrini,1989). A particular emphasis should be given to a correct and precise description of what is the behavior to be analyzed.

Second, users need to be aware of the fact that, when used appropriately and reliably, systematic observation produces only descriptive information that is relatively objective. This is an important limitation. What the user of this descriptive information does with the information can become evaluative in nature depending on how it is interpreted.

Users of informal analysis have a tendency to make evaluative or judgmental notes and thus superimpose their own beliefs and biases on what they see

happening. The use of specific coding rules (descriptors and indicators) and procedures in systematic observation forces the observer to first describe the events as accurately as possible and then, based on that descriptive base, make some suggestions for improvement where necessary or reinforce the existing level of performance. The data themselves do not make a judgment about how well or poorly the player performed, rather they provide the information for judgments to be made later.

A third limitation is that descriptive data in and of themselves cannot give prescriptions as to what a practitioner could (or should) change.

Fourth, findings obtained through systematic observation are always contextual. In other words, the message they may provide about players' performances needs to be considered in light of the situation in which they were observed.

10.3. The Process of Systematic Observation

The process of Systematic Observation, applied to sport performance's analysis, is far more complex of what reported previously and one might have a clear vision while using this line of research in a scientific way (Carling et al.; 2004).

Systematic Observation involves more than merely going into a gymnasium or a to a pitch with an observation system and collecting data on some selected behaviors and events. The acts of observing and recording behaviors are preceded by a number of steps that need to be taken to ensure that the data to be collected will be **reliable, accurate, and valuable** (Korenberg, 1983).

The process of **Systematic Observation** involves the following critical steps:

- **Deciding what** to observe.
- **Developing definitions** for the behaviors to be observed.
- Selecting the most appropriate **observation tactic**(s) and determining if there is an existing **observation system** that fits the need of the observer.
- Establishing **observer reliability**
- Making the **observation**
- **Summarizing** and **interpreting** the collected data

10.3.1 Deciding What to Observe

Observation of sports events is a prominent activity in both research and supervision functions. When part of a research project, observers base their observation focus on the research questions asked. This could be a **descriptive, correlational, and/or experimental question**. In the supervisory function observation is also used to determine performance levels of a great number of technical/tactical skills of players.

The crucial thing here is that there is a specific **focus or goal**. Observation either for the sake of observation or without any particular goal is a **fruitless activity**.

There are many different kinds of behaviors, events, and episodes that can be measured and analyzed, during a Match. It is important to remember that regardless of what aspect of the Match is observed, it should always be tied into some type of goal.

10.3.2. Developing Definitions

As indicated earlier, it is very important to have specific definitions of the behaviors to be observed. Well-developed definitions make the observer's job of discriminating whether an event constitutes an instance of the target behavior much easier. Disagreement between observers can be minimized when definitions are clear, complete, and objective (Hawkins and Dobes, 1977, Domenici, 1991). Typically, the target behavior is first described in more general terms. Once that rough outline is in place the final definition is developed. This definition focuses on either of two aspects of the behavior, namely its topography or its function (Barlow & Hersen, 1984).

When the topography (i.e., the form) of the behavior is emphasized, the definition describes the movements that make up the behavior. However, if function is emphasized, then the definition needs to focus on the outcome or consequence of the behavior. For example, if data were needed on the ability of players to serve overhand in volleyball, it could be described in terms of its physical form. The definition would then most likely include descriptions of foot position from the baseline, point of contact, follow-through, and so on. A definition of the same behavior in terms of its function would most likely include such indicators as "ball

will pass over the net and land inbounds in the back third of the opponents' court." Barlow and Hersen (1984) emphasized that regardless of which type is used, the definitions should be meaningful and replicable. Furthermore they noted some characteristics of good definitions:

"They avoid references to intent, internal states, and other private events.... Complete definitions include the following components (Hawkins, 1982):

- *a descriptive name; a general description, as in a dictionary;*

- *an elaboration that describes the critical parts of the behavior;*

- *typical examples of the behavior*

- *and questionable-borderline or difficult examples of both occurrences and nonoccurrences of the behavior."*

10.3.3. Selecting the Most Appropriate Observation System

 Each behavior or event has two specific dimensional characteristics. The first one is **repeatability** (Johnston & Pennypacker, 1980), which refers to the fact that a behavior can occur over and over again; that is, there is a **frequency** to each behavior. Certain behaviors typically occur a lot, whereas others may occur only a few times over a long period of time. In other words, there is a **pattern to their frequency**.

   A second inherent feature of each behavior is that it takes time to complete. There is **duration** to each behavior. Certain events last only very short times, whereas others last longer. Both **duration** and **repeatability** are critical in the analysis of sports performances. Once the definition of the behavior has been developed, one needs to decide whether the behavior is best characterized by its **frequency of occurrence** or **typical duration**.

10.3.4. Establishing Observer Reliability

Once a person decides which system to use, he or she needs to develop a sufficient level of **reliability**. Reliability is a critical feature of the process of observing systematically, because it is a prerequisite for collecting accurate data. Reliability is most often measured by the degree to which two persons using the same definitions

and coding procedures and viewing the same activities agree on their codings. Observer reliability is established through sound training of the observers.

Equation *10.1* is used to calculate the percentage of agreement between two observers (or two separate observations of a single observer). In this equation an agreement would be an aspect of the total observation for which both saw or heard the same behavior and recorded it as such. As will become clear later on, if both observers code the absence of behavior this is also considered an agreement.

$$\underline{\text{\hspace{2em}Agreements\hspace{2em}}} \text{ x 100} \qquad (10.1)$$
$$\textbf{Agreements + disagreements}$$

Disagreement occurs when the two observers differ on a particular aspect of the observation. Differences in observation records can take on two forms. First, the difference could be one of omission, where one observer detects and records the behavior and the other does not detect or record anything. For example, during an interval recording session one of the two observers simply did not see that the target student completed a trial at the throwing station, whereas the other observer did. The causes for not seeing the behavior, of course, could be manifold.

Second, a disagreement occurs when both observers code an episode as having occurred, but one records it as being one type of episode (e.g., striking to goal), whereas the other records it as being another (e.g., passing a ball).

This basic equation is used with **event recording**, **duration recording**, **interval recording**, and **Group Time Sampling** (or momentary time sampling), but the resulting percentages may take on a different meaning for each.

10.3.5. Making the Actual Observations

There are some important considerations observers need to be aware of once they are ready to go into a setting where the observation is going to be held. Primarily, one needs to be concerned with the definite possibility of **subject reactivity**, particularly if it is the first time that players or coaches are observed: their behavior may change simply because of the presence of observers. However, after a few sessions their behavior tends to return to its regular pattern. There are a few things that observers can do to minimize their influence on those first few visits. It is a good

strategy to suggest to the coach that he or she explain to his or her athletes the presence of the observer(s) in general terms, without specifying the exact purpose. In addition, the observer should arrive in the setting early enough so that he or she can start as soon as the first athletes enter. This way, the routine of what coaches and players do is less likely to be disrupted. The observer should try to be as inconspicuous as possible, both in dress and behavior. Furthermore, it is best to avoid interaction of any kind with players. If they seek contact it is suggested to be general but courteous. Also, if a specific player is the target of observation, the observer needs to ensure that he or she disguises the attention through varying his or her glances.

With regard to the use of audio or video equipment, if cue tapes and earphones are used, try to keep the equipment out of sight as much as possible. Video equipment should be positioned in the same location on each visit. Battery-operated equipment (computer, video cameras, wi-fi devices, etc.) should be checked prior to the visit.

10.3.6. Summarizing and Interpreting the Data

If data are collected for supervisory purposes they need to be summarized in such a way as to provide feedback to the coach. If they are collected for research purposes they need to be converted into values appropriate for further (statistical) analyses (Ruscello et al., 2008b).

10.4. Basic Recordings Tactics

This section provides an overview of the recording tactics fundamental to all the quantitative systems presented in this thesis.

Each of these systems has its roots in one (or a combination) of four recording tactics:

1. **event recording**
2. **duration recording**
3. **interval recording**
4. **momentary time sampling.**

As mentioned previously, systematic observation involves both observing and recording. Johnston and Pennypacker (1980) noted that "the goal of observation is to arrange conditions so that man or machine will react sensitively to the defined dimensions of the subject's behavior".

In contrast, the act of recording provides a permanent and accurate record of the observations for future examination.

Following is a detailed description of each of the four recording tactics.

10.4.1. Event Recording

One of the core properties of observable events or episodes is that they can occur over and over again. Event recording is the appropriate tactic for collecting data on this particular aspect of events and/or behaviors. Event recording provides the user with data on the frequency of occurrence of a discrete event. It tallies the number of times that this event took place (Cooper, 1974).

The word **discrete** is critical in this context. The observer must be able to discriminate a definite beginning and end to the event. For example, in the case of the student shooting the puck, the beginning of this event will be the initiation of the backswing and the conclusion of this event would be the end of his or her follow-through. The beginning and end of a verbal statement are, of course, characterized by the first and last word of that statement. Event recording thus provides a numerical account of the occurrence of events.

Reporting Event Recording Data

If the length of the observation period is constant across sessions, **frequency** is the appropriate unit of measurement in reporting event recording data. If the length of observation varies from one session to the next, then the **rate of response** is more appropriate. The rate of behavior is calculated by dividing the recorded total frequency by the length of observation. The length of observation is typically measured in minutes; hence, the resulting number would be the **rate per minute** (**RPM**) (Ciuffarella and Ruscello, 2008).

Although not used as often as frequency and rate, **ratio** and **percentage** are two additional means of reporting frequency data. **Ratios** are used to indicate the relationship of one behavior pattern to that of another.

At times frequency data are also expressed in percentages. Event recording data expressed in this fashion have their analog, for example, in athletes' game performance statistics.

With **well-defined category definitions**, event recording is quite easy to use. There are two situations in which event recording should not be used. Both situations influence the reliability and/or validity of the data. First, if the behavior can occur at extremely high rates, **event recording** is inappropriate. The observer would probably not be able to keep up with the rapidity of the behavior and still be reliable. For example, it would be difficult to count the number of times that a player dribbled the basketball during practice and maintain a high level of reliability.

Second, a behavior or event can last for extended amounts of time. If that is the case, event recording again would not be the correct choice of observation tactic.

10.4.2. Duration Recording

A second pivotal dimension of behaviors, events, or episodes is that they can last for extended periods of time. If this dimension is the major focus, **duration recording is the appropriate tactic**. This tactic is used, for example, to collect data on the time ball possession is kept during a match by an observed team.

As indicated in the previous section, certain behaviors occur at such high rates that event recording is not the appropriate tactic. If this is the case, such as in the dribbling example, then duration recording is the appropriate observation tactic. Duration recording thus provides a temporal account of the observed events. When using duration recording, the observer focuses on the whole team, a subgroup of the team (i.e. the defensive unit), one individual player, or the coach.

Alberto and Troutman (1986) and Cooper, Heron, and Heward (1987) differentiated another type of recording procedure that also focuses on temporal dimensions of events: **latency recording**. Latency recording measures the time that elapses between a stimulus or cue and the beginning of the response. The only difference between latency recording and duration recording lies in their respective foci. Conceptually, duration recording starts where latency recording ends. Duration recording measures the time elapsed from the start of a behavior or event until its

end. Measuring the amount of time between a coach's signal for attention and the players' exhibiting that attentive behavior is one example of latency recording. Johnston and Pennypacker (1980) proposed another type of latency, namely, that of time elapsed in between two instances of the same behavior, or Interresponse Time (IRT). Examples of situations or events in physical education and sport settings where latency recording is useful would be the time elapsed between one free throw attempt to the next, one archer's shot attempt to the next, one shot on goal to the next in hockey or soccer, one vault attempt over the horse to the next, and so forth.

Reporting Duration Recording Data

The standard units of measurement for such data are minutes and seconds (Ruscello and Iaccarino, 1995). As was the case in event recording, if the length of the observation period is a constant (e.g., 40 minutes) across all observations, then the data are reported in the original unit of measurement. However, if it varies in length from one session to the next, then the original data need to be converted to percentage of observed time.

Percentage of observed time is calculated by using the following equation:

$$\frac{\textbf{Episode total (seconds)}}{\textbf{Total time of observation (seconds)}} \textbf{ x 100} \qquad \textbf{\textit{(10.2)}}$$

The denominator (total amount of observed time) could be the whole match or practice session, or only specific portions of it. If it encompassed the complete game or match, the label of the denominator would be "percent of Match time."
If the numerator and/or the denominator exceed 60 seconds, those values need to be converted to seconds. For example, if the observation lasted 33 minutes and 38 seconds, and during that time the player was off-task 7 minutes and 12 seconds, both values are converted to total seconds first before the division is calculated. Hence, 452 seconds is divided by 2,038 seconds, and the resulting value is multiplied by 100. The off-task behavior is 22.1% of the observed time.

10.4.3. Interval Recording

Interval recording allows the observer to measure the occurrence or non-occurence of behavior within specific intervals. The total observation period is divided into short intervals of equal length. The range of interval length is normally from 6 to 30 seconds. The choice of interval length depends on two major factors.

First, the observer's level of experience in accurately observing and recording behaviors is of influence. As the observer becomes more skilled in detecting the occurrences of events, the interval length can be shortened. Second, the complexity of the observation system also governs the minimum length of the interval. On the one hand, if the observer is focusing on only a single behavior, and thus is concerned with a dichotomous decision, then the interval length can remain quite short. On the other hand, if the observation system includes multiple categories, thus forcing the observer to make a decision from a greater number of choices, then the interval length needs to be increased.

How to Report Interval Recording Data

The unit of measurement for interval recording is frequency of intervals. However, in virtually all cases its derivative, percentage of intervals in which the behavior(s) occurred, is used for reporting such data. Percentage of intervals is calculated by dividing the total number of intervals in which the behavior occurred by the total number of intervals observed, multiplied by 100.

Total Number of Interval with the observed behaviors x 100   *(10.3)*
                    Total Number of Interval observed

10.4.4. Momentary Time Sampling

Momentary time sampling is similar to interval recording in that the observation session is also divided into time intervals. However, the critical difference lies in the time when the actual act of observation takes place. Figure 1) displays the difference between the two tactics graphically.
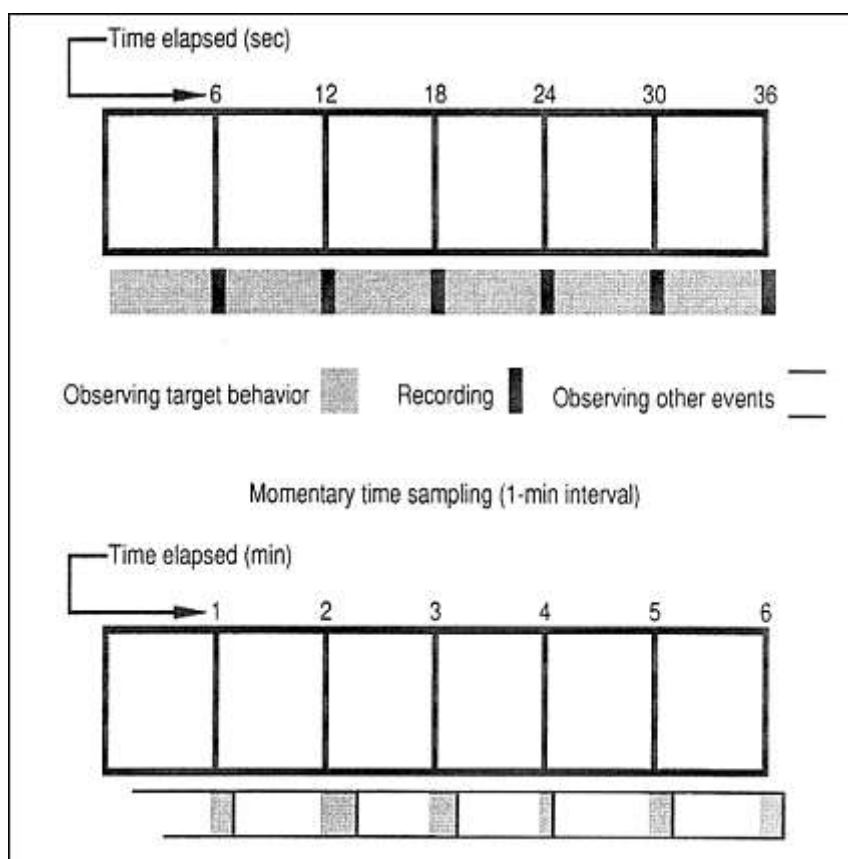
Figure 1 Difference between interval recording and momentary time sampling in terms of the sequenze and duration of the observation and recording act.

In interval recording the act of observation starts at the beginning of the interval and continues throughout the entire interval, whereas in momentary time sampling the observation act occurs at the end of each interval. After the observation is made the observer marks whether or not the behavior(s) occurred on the coding form.

Most often the length of the interval (i.e., the time in between the actual observation) is longer than that used for interval recording, ranging anywhere from 1 to 10 minutes. The length of the interval depends on the combination of the duration of the total observation session and the number of samples needed. Usually the time intervals are of equal length; however, one can also use variable time intervals. This

guards against situations in which the pace of the activities matches the instances where the observation takes place in such a way that the validity of the data is threatened severely. For example, a session in which athletes are working on various skills at different work stations usually includes rotating groups from one station to the next. If the time spent at each work station is constant (e.g., 2 minutes) and similar to the length of the time intervals for the observer, it is quite possible that the end of the time interval falls during the rotation. If the observer were measuring the level of motor engagement of the athletes, the resulting data would indicate a much lower (possibly zero) percentage than what actually happened. Test and Heward (1984) described how a variable schedule of momentary time samples can be developed: a random numbers table was used to generate numbers between 1 and 1800, representing the total number of seconds in a 30-minute session. The random numbers were selected and placed on a number line, with the criterion that no two numbers could be less than 10 seconds apart, until 30 observation points had been marked. The list of numbers was then used as a guide for making the variable interval time sampling cuing tape.

Although this tactic is used most often for collecting data on one behavior (or individual), it is also used for monitoring a few behaviors (or individuals). Furthermore, it is used to measure the patterns of behavior (Needham, 2003) of large groups of individuals (i.e. a Team competing in a Match). This last one is also called **placheck** (planned activity check) recording (Doke & Risley, 1972; Siedentop, 1983) or Group Time Sampling (GTS).

Reporting Momentary Time Sampling Data

Data collected with the use of **momentary time sampling** are reported as percentage of total intervals. If a few behaviors or individuals are observed, percentages are calculated for each individual one. In placheck recording, however, the unit of measurement becomes percentage of athletes/players. This is calculated by dividing the total number of players exhibiting the target behavior across all samples by the total number of players observed across all samples (equation 10.4):

<u>**Total number of players performing the desired behavior x 100**</u>   *(10.4)*

Total number of samples x total number of players

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Chapter 11

Match Analysis and the possible Professional Profiles

Introduction

In this pilot study we examined the possible fields of intervention related to the Match Analysis procedures in Team Sports methodology and the Match Analyst professional profile, whose relevance is gradually increasing within the coaching staffs of high level teams. We also focused on the possible education and on the required training aspects of such a profile, investigating some relevant attitudes of the Sport Sciences students at the University of L'Aquila (Italy), through a structured questionnaire, designed by the authors.

The main aim of this research is providing an overview about the attitudes of these potential sport insiders or experts, referring to:

1. their knowledge and the perceived relevance of the Match Analysis as an objective and specific methodology of assessing the Team Sports performances;

2. their knowledge and the perceived relevance of the Match Analyst's work within the frame of a Coaching Staff;

3. their general attitude towards the training and the education processes, specifically designed in order to qualify the Match Analyst. These aspects involved how much time and money they would be inclined to spend for and at what level and by whom that training/education process should be organised.

Match Analysis procedures are as many as the possibilities of investigation in the context of the Situation Sports, including Team Sports, and they aim at analysing the different aspects of the complex structure of the sport performances *(Hughes M., Franks I.M; 2004; Carling C.,Williams M., Reilly T.; 2005; Sacripanti A., 2007; Ruscello B.; 2008a).*

One could be mostly interested in analysing a first level of performance, the one related to the physiological side of the game *(Murphy A.; Lockie, R.G.; Coutts*

271

A.J.;2003; Spencer, M.; Bishop, D.; Dawson, B.; Goodman, C.; 2005; Bonsignore D.; Ruscello B.; 2006;). Other ones could be more interested in analysing the biomechanics of the game *(Stuelcken M.C.; 2003; Sacripanti, A., 2004; Camomilla V., Cherubini D.; Ruscello B.;2008;)* or the strategic and/or the tactical side of the sport *(Kormelink, H.; Seeverens T.;1999; Laird, P.; Sutherland, P.; 2003; Ciuffarella A.; Ruscello B.; 2008; Ruscello B.; Iaccarino G.; Sacripanti A.; 2008b).*

In every case a highly trained and qualified personnel is required in order to ensure effective, useful and scientific analysis of the performance.

In this chapter we will provide an overview of what is currently the most used aspects of Match Analysis, (Dick F.; 2005; Madella A.; 2007; Sacripanti A.; 2007) also focusing on the specificity of a new professional profile, the Match Analyst, and the attitudes performed by possible future Match Analysts, such as the Sport Sciences Students, through a questionnaire opportunely designed.

11.1. Talent Scouting and Guiding

One of the most difficult task in modern sport, and generally speaking in sport pedagogy, is Talent Scouting and Guiding .

Many researchers in different sports (*Regnier et al., 1993*; *Williams and Reilly, 2000*) highlighted the difficulties faced by the coaches and other insiders when asked to make prediction on what could be the future career of a young athlete or player. As stated by many researchers and scholars *(Carbonaro, Madella, Manno, Merni and Mussino, 1988; Pieron,1989; Sotgiu and Pellegrini, 1989; Domenici G.; 1991; Donati, Lai, Marcello and Masia, 1994; Madella, Cei, Londoni, Aquili, 1994;)* an important role in sport pedagogy is played by the **observational procedures** carried out in order to assess and evaluate the training process in youth sport.

A poor observational plan, both in term of intrinsic structure and/or in lack of proper devices, could lead to wrong assessments, subsequently leading to wrong programmes and, very often, to the "burn-out" phenomenon *(Martens, 1987; Bull, 1991; Malina, 2006; Orlink, 2007)*, namely boys and girls going away from sport. So Match Analysis could be a key factor in providing an objective feed-back to the young athletes and to the coaches, in order to ensure to each of them the best information, suitable to promote the best programming process for any future development.

Therefore the young athletes' careers, involved in situational sports, could greatly benefit from a systematic approach of Match Analysis, especially when their careers are facing crucial period of selections, qualification or important stages of training and competitions.

Again we must emphasize the relevance of Match Analysis in the context of Sport Pedagogy. Information not aimed at winning in that precise moment (here and now) but information linked to development planning, based upon objective feed-backs. This introduces the important concepts of "Data-Base Training[1]" and "Longitudinal Studies" referred to Youth Sports.

Specific training and education are required to highly qualify this personnel.

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[1] In October 2007, CONI – Scuola dello Sport organised the Seminar "The Database Training". It has been one of the first time that this concept was introduced to the Italian Sport environment. More details at:
http://scuoladellosport.coni.it/fileadmin/documenti/doc_corsi/PDF_corsi/Corsi_rossi/Programma_4_Sem_database.pdf

11.2. Tournament Match Analyst

This is a specific professional profile, referred to a particular aspect of this Methodology. It is well known that many sports are based on a competition structure called Tournament (World Cup, Olympic Games, etc.). This kind of Tournament usually lasts less than 15 days, with Matches played almost every day.

The key factor, under the Match Analysis point of view, is the ability to collect information and data as faster as possible and to analyse them even faster, in order to provide the Coaches and the other insiders with the relevant information about their and/or the opposing teams. Being able to synthesise meaningfully all the amount of collected data, is the most appreciated quality of this particular Analyst.

Emphasis is set on the Qualitative Analysis of the Technical, Tactical and Strategical aspect of the Match, thus underlining that this specific kind of analyst requires the highest level of reading and understanding the game abilities, practically while the Match is going on.

A Computerized Video-Match Analysis approach is the one most used at date. The last frontier is represented by a Real-Time approach, namely a methodology suitable to provide a consistent help to the work of the coaches just during the Match taking place.

Specific training and education are required to highly qualify this personnel.

11.3.   Championship / League Match Analyst

The domestic or National Leagues or Championships, in many Team Sports and in different nations, (p.e. in football: the Italian *"Serie A"[2]*, the German *"Bundesliga"[3]*, the British *"Premier League"[4]* or the Spanish *"la Liga"[5],* just to mention a small example), last for several months, also having the possibility to employ different players, coming from different clubs, throughout the ongoing season.

Match Analysis in this case is aimed at two different sides:

a. Analysing a particular ongoing match (as in Tournament Match Analyst)

b. collecting information for future analysis, always up-grading the relevant data-bases, in order to cope with the evolution of the observed sport system (different places, different pitches, different weather conditions, different players, mobility of players throughout the sport system during the season, evolution of rules, etc.).

A Match Analyst particularly involved in this side of the analysing methodology has to be able to gather and store a huge amount of information *(Ciuffarella e Ruscello, 2008)* , and to make the relevant connections among a myriad of observed variables. **Data Mining** routines *(Han, J., Kamber, M.; 2001; SPSS inc. 2004; Solieman, O.; 2006; Ruscello B.; Iaccarino G.; Sacripanti A.;2008)* can really help on this matter. 0

Specific training and education are required to highly qualify this personnel.

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[2] http://www.lega-calcio.it/
[3] http://www.bundesliga.de/de/
[4] http://www.premierleague.com/page/Home/0,,12306,00.html
[5] http://www.lfp.es/

11.4. The Opposing Teams Match Analyst

Currently many Match Analysts are committed to collect information and data about numerous Teams/Athletes, not being really a member of a specific Coaching Staff or Team, but ready to provide critical information to possible *"clients"* interested in their services. Internet is full of such information or services, but most of them are of a poor quality/quantity.

At high level this particular aspect of the Match Analysis methodology could be also applied by a member of a Coaching Staff, in preparation to a Tournament or a League. It might involve the need of "travelling a lot", always looking for information (often classified..) directly in the place where the opposing teams are training or preparing. The analogy with an Intelligence Service committed in war operations, is quite clear. This particular aspect of Match Analysis is still raising important ethical issues.

As in the previous case, a Match Analyst committed to this aspect of the methodology has to be able to gather and store a huge amount of information, and to make the relevant connections among a myriad of observed variables. Again **Data Mining** routines can efficiently help on this matter.

Specific training and education are required to highly qualify this personnel.

11.5. An Applied Research: the Attitudes of Sport Sciences Students about the Match Analysis process.

One of the main aim of this research is providing an overview on the attitudes of possible sport insiders or experts, referring to the relevance of the Match Analysis as a mean and /or a specific methodology of objectively assessing the performances in Team Sports. We focused either on the relevance of the Match Analysis processes and on the training/education procedures, needed to qualify at different levels such a professional profile.

MATERIAL AND METHODS

The Attitudes of Sport Sciences Students about the Match Analysis process.

On July 2008, 100 questionnaires, designed by the authors, were distributed to the students. 40 questionnaires have been returned to us (with a ratio of 40%) and we were able to process and statistically analysed them, using the software "SPSS for Windows, 13.0".

The collected data, statistically processed, provided a basic information, suitable to design possible curricula to be implemented in future training courses aimed at educating the future Match Analysts.

The questionnaire investigated the attitudes of the students referring to three main areas:

- **General knowledge of the Match Analysis procedures/ Match Analyst related issues.**

- **Match Analysis in the context of a Coaching Staff.**

- **Match Analyst Education and Training Programme.**

11.5.1.   Attitudes

Generally speaking, psycho-sociologists investigate attitudes (AschT.,1985; Aronson E., Wilson T.D., Akert R.M.,1997)**.**

The human being, in his limited world, is continuously forced to face the same "subject" or "experience".

The knowledge, the feelings and the inclinations, so often evoked, are organised in a unitary and lasting system. Indeed the *"human being is an animal who organises and stores".*

This system of beliefs, feelings and specific answers is always available, ready to be used when the individual meets the appropriate subject: thus an **attitude** towards this specific subject is formed.

As the human being acquires more and more attitudes, his capacity of re-examination and interpretation decreases. His actions become **stereotyped, predictable and coherent** (and social life, according to this vision, becomes possible).

In fact if lasting beliefs, appraisals and shared inclinations to act were not there, social life, as we know it, will be impossible.

Understanding attitudes is one of the most important issue in social psychology (Lewin K., 1972; Krech D., Crutchfield R.S., Ballachey E.L., 1980; Mantovani G.,2003).

The **knowledge** of a subject, the **deep feelings** it evokes and the **inclination to act** towards this subject, form the system that we call **attitude**.

The social actions of an individual reflect his attitudes: lasting system of positive or negative evaluations, feelings and tendencies to act in favour or against the social subjects that form his/her environment.

Anything may be the subject of an attitude: people, groups of people, social, political or economical organizations, art, philosophy, professions, God or anything else, including the "himself".

However a limit to the possible number of attitudes does exist.

In fact the individual can have attitudes only towards the subjects that exist in his psychological world.

If his psychological world is limited, so do his attitudes.

11.5.2.   The components of the attitude

Attitude may be defined as a firm system formed by three components, centred on a single subject (Mantovani G.; 2003).:

1. The beliefs concerning the subject: **the cognitive component;**

2. The emotions concerning the subject: **the emotional component;**

3. The tendencies to act toward the subject: **the acting component.**

The **cognitive component** of the attitude is formed by the beliefs of the individual concerning the subject. The most critical beliefs embedded into the attitude system are the opinions based on evaluation.

They imply the attribution to the subject of qualities such as: *favourable, not favourable, desirable, not desirable, good, bad, in accordance with my requirements, not in accordance with my requirements.*

The **emotional component** of the attitude is formed by the feelings of the individual concerning the subject. The subject is felt as *agreeable, not agreeable, nice or not nice.*This emotional charge makes the attitudes persistent, stimulating and motivating: if people like or not a subject (in our case this new professional profile in a specific and "difficult" labour market), people will appreciate or disqualify it, starting from a predetermined point of view.

The **acting component** includes the individual's real availability and willingness to do, referring to a specific subject.

If an individual has got a positive attitude toward a specific subject, he will be available to help, promote or support that subject, whereas if he has got a negative attitude, he will work to damage, punish or even to destroy that subject.

Each of the three attitude component can vary in **Valence** and in **Complexity Degree**.

As previously reported, an attitude may be positive or negative, although describing it by indicating its sign only, is not enough. In fact we need to measure quantitatively its **Valence**.

The **cognitive component** of an attitude may be extremely favourable: in that case the individual thinks about a subject as the best thing in the world, whereas this component can be also extremely negative and the individual may believe that subject as the worst thing in the world.

Even **the emotional component** varies in the same way. People may love or hate the same subject with a great intensity.

So does the **acting component**. People can work hard to support and protect or, vice versa, to attack and destroy the subject.

The **Complexity Degree** refers to the variability, in terms of quantity and quality, of the elements that form the components.

Therefore the **cognitive component** may include a broad list of beliefs concerning the subject, the **emotional component** may be a relatively simple and not differentiate love for that subject and the **acting component** might be a complex one, because the individual is ready to start many and various protective actions for the sake of that subject.

The whole attitudes of an individual form his **configuration** of attitudes.

280

The attitudes may vary for their degree of isolation or connection to other attitudes too.

People think that only few attitudes can be in a complete isolation state. Indeed most of them form **clusters of attitudes**.

Those clusters interrelate with themselves influencing in the same individual his attitude toward a single subject. His political, religious, artistic or scientific background, his experiences or his own history continuously affect the way he look at the world and judge it (Tesser, 1995).

11.5.3.   Measuring the Attitudes: the Scales

In order to utilise the concept of attitude to understand and to predict the behaviour of individuals, we need valid and reliable measures (Likert R., 1932).

Measuring attitudes is always indirect, as it happens in all the psychological determinants. Attitudes may be measured only by deductions based on the answers given by the individual toward a subject: his concrete actions, his declared beliefs, his feelings and his inclination to act toward the subject.

The Attitudes Scales are the most used and well designed and experienced tool among all the measuring methods ever used.

The scale technique was designed in order to transform a series of qualitative values into quantitative ones.

An attitude scale is formed by a certain number of statements (items); the answers given by an individual can provide the chance to make some deductions on his attitudes concerning the investigated subject.

11.5.4.   Designing the questionnaire

We have designed 20 items with different modality of answer:

- The agreement degree (I totally disagree-I totally agree);

- Choosing a statement that better fit the personal opinion.

In order to investigate the attitudes (*Likert R., 1932; Frudà L.,1987; Aronson E., Wilson T.D., Akert R.M.; 1997)* of the Sport Sciences Students concerning the relevance of the Match Analysis procedures, the Match Analyst role and possible training, we designed a questionnaire according to this lay-out:

1. *A Section One,* including:

- *Personal Bio Data,* aimed at receiving information about some general biographic data (age, gender), the training period at the university (Degree, Class) and a *Self Evaluation* paragraph, regarding some specific area of knowledge (Mathematics and Statistics, Information Technology, Personal Knowledge about some Match Analysis issues, etc.) .

- the *Aims of the Research and Questionnaire Protocol* paragraph, designed in order to provide a short outline of our project of research and to give some simple instructions about filling the questionnaire;

- *A General Definition of Match Analysis and Match Analyst* aimed at providing a first introductory background of the investigated issue.

Section one was designed to organise the sample while processing the data, in order to investigate possible meaningful differences with and within the group of the analysed person (according to sex, age, specialisation, years of experiences, personal knowledge, etc.).

The questionnaire was then formulated with 20 items, investigating:

- **Section Two:** the general attitude of the student regarding the Match Analysis main issues, seen under different points of view (items1-4);

- **Section Three:** the attitude of the student regarding the possible relevance of the Match Analyst in the context of a Coaching Staff and as a part of a Team Working Unit (items 5-11)

- **Section Four:** the attitude of the student regarding this new professional profile, his training, his very *inclination to act* in order to qualify himself as an expert in this field (items 12-20).

11.5.5.   The proposed questionnaire

"Match Analysis in Team Sports and related professional profiles"

Personal Bio Data

Date_____

_____

Age_____   Gender (M ◊   W ◊)

Degree Course and Class: Bachelor's Degree ◊   1° ◊   2° ◊   3° ◊
Other ◊

                    Master's Degree ◊   1° ◊   2° ◊   Other ◊

Athletic Discipline: Individual Sport ◊   Team Sport ◊

Self evaluation

Video and Information Technology Skills

None	Bad	Sufficient	Good	Excellent
1	2	3	4	5

Statistics and Mathematical Skills

None	Bad	Sufficient	Good	Excellent
1	2	3	4	5

**Knowledge of the professional profiles
active in sport environments**

None	Bad	Sufficient	Good	Excellent
1	2	3	4	5

Knowledge of the MATCH ANALYSIS issues

None	Bad	Sufficient	Good	Excellent
1	2	3	4	5

Aims of the Research and Questionnaire Protocol

        Aim of this research, carried out at the University of Sport and Motor Sciences of L'Aquila, is collecting data about the way a professional profile referred to the Match Analysis process is perceived and known by the students, how important could be, and which professional fields could employ.

        There are no right or wrong answers, since they will be personal opinions and they will not be scored in any way. You are kindly requested to answer precisely and to put your questionnaire, once completed, into the enclosed envelope. The questionnaire is anonymous and it will take few minutes to be completed. It is really important to choose the right level of agreement, utilising the proposed graduated scale, choosing the level that fit better your expectations or thought. Please, use only one of the five options provided (see example below).

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Exmples

1) Less than…   ◊
2) From …up to ◊
3) From …up to ◊
4) From …up to ◊   ✗
5) More than…   ◊

A General Definition of Match Analysis and Match Analyst

Match Analysis, in situation sports, such as Team Sports, is a branch of Sport Pedagogy and Sport Sciences. Several disciplines, at different levels and extensions, combine to bring descriptions, classifications, eventually explanations and to provide possible forecasts, on probabilistic basis, about some of the most significant situations that could be marked during sport events or matches.
Match Analyst's more important tasks are collecting, analysing, synthesizing and preparing in a convenient way, all the significant information, obtained through suitable methodologies and according to systematic observation plans, previously designed and agreed with the Coach and the Technical Staff.

<1> *According to my experiences and having read the general definition of Match Analysis above mentioned, I believe that:*

1) **Match Analysis in Team Sports is a constantly growing methodology.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

2) **The value of the Match Analyst's professional profile is widely appreciated throughout the sport world.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

3) **It is not necessary a specific training to work as Match Analyst.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

4) **Match Analysis has no role in the context of Youth Sport.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

<2> *According to my sport experiences I believe that:*

5) In modern Team Sports, the Coaching Staff working as a unit is crucial issue: the Coach, on his own, will never be able to manage properly all the complexities of training and coaching a team, without the help of highly trained personnel.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

6) The Match Analyst greatly contributes in training and coaching a High Performance Team, together with other professional profiles (the Coach, the Fitness Trainer, the Assistant Coaches, the Medical Doctors, the Psychologist, the Physio, etc.)

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

7) The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own experience.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

8) The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own observational and mnemonic skills.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

9) The number of people of the Coaching Staff, dedicated to the Match Analysis procedures, should be:

a) None ◊
b) 1 ◊
c) 2 ◊
d) 3 ◊
e) More than 3 ◊

(please, just one answer)

10) A Top Level Technology is definitely required in order to provide procedures of Match Analysis suitable to high level Team Sports.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

11) Match Analysis is just a moment fashion. It will go probably out of style sooner…

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

<3> According to my professional experiences and to my educational training:

12) I consider useful the organization of a specific Training Course for Match Analysts.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

13) This Training Course should be organized by Sport Federations and by the National Olympic Committee.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

14) This Training Course should be organized by the Sport Sciences Universities.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

15) I consider this Professional Profile really interesting and I would like to attend a specific Training Course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

16) This Course should be designed with an amount of education time suitable to qualify highly trained personnel.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

17) I think appropriate for such a Course an amount of time of:

a.   Less than 50 hours   ◊
b.   50-100 hours   ◊
c.   101-200 hours   ◊
d.   201-400 hours   ◊
e.   More than 400 hours   ◊

18) This Training Course (for Match Analyst) should be designed at this level:

a.   Basic Sport Training Course (Sport Federations, Olympic Committee)   ◊
b.   Dedicated Class within the Sport Sciences Bachelor's Degree   ◊
c.   Dedicated Class within the Sport Sciences Master's Degree   ◊
d.   Italian Master, level 1   ◊
e.   Italian Master, level 2   ◊

19) In order to attend this Course, I would spend this amount of money:

a.   Less than €200   ◊

b. €201-500   ◊
c. €501-1.000   ◊
d. €1.001-1.500   ◊
e. €1.501-2.000   ◊

20) I expect this specific education suitable to let me enter the top sport world as an highly qualified expert.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

DATA PROCESSING AND ANALYSIS

All the frequencies were tabulated in order to provide the respective percentages for all the possible answers to the proposed items.

A descriptive statistic (mean, standard deviation, range) for the agreement degree scored 1 to 5 for the suitable items it has been also provided.

These central tendencies were useful to describe the average attitudes of the Sport Sciences Students and they also allow to compare the different means found in specific sub-groups of the sample.

In order to verify the possible significant differences existing between the sub-groups in this case, the "One sample T- Student Test"[1] has been also used.

Moreover a Chi-Square Test[2] was applied to all the suitable items, in order to exclude the Null Hypothesis and to accept the Alternative Hypothesis (the

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[1] The One-Sample T Test procedure tests whether the mean of a single variable differs from a specified constant. The mean value is displayed in the One Sample Statistics table, and the constant is test value displayed in the One Sample T Test table. A low significance value (typically below 0.05) indicates that there is a significant difference between the test value and the observed mean. If the confidence interval for the mean difference does not contain zero, this also indicates that the difference is significant. If the significance value is high and the confidence interval for the mean difference contains zero, then you cannot conclude that there is a significant difference between the test value and the observed mean.

[2] The Chi-Square Test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

Small significance values (<0.05) indicate that the observed distribution does not conform to the hypothesized distribution.

differences between the observed frequencies and the expected ones were significant (P<0.05), and not casually distributed within the sample, due to relevant factors).

11.5.6. Statistical analysis

Delivered Questionnaires	100
Processed Questionnaires	40
Ratio D/P	40%
Processed Items	1120

Personal Bio Data

Age

Statistics

Age

N	Valid	40
	Missing	0
Mean		25,2750
Median		23,0000
Mode		23,00
Std. Deviation		5,33488
Range		25,00
Minimum		20,00
Maximum		45,00

Histogram

Mean = 25,275
Std. Dev. = 5,33488
N = 40
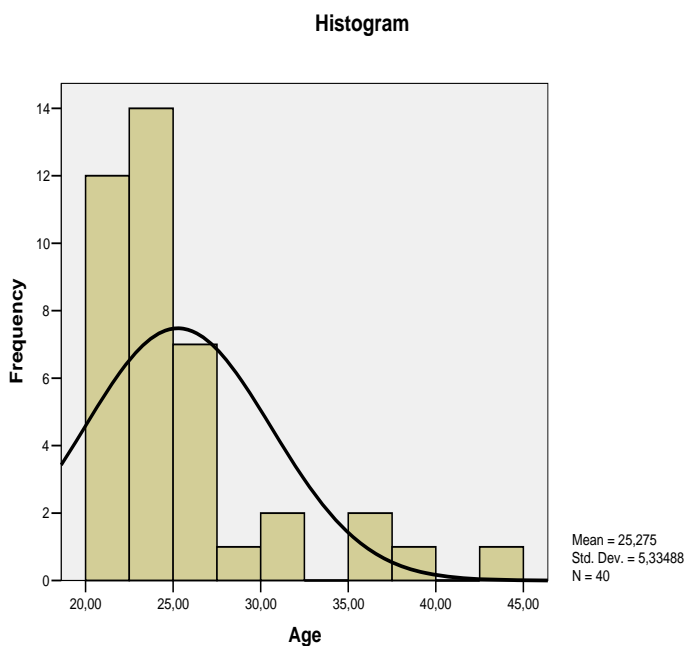
Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	5,0	5,0	5,0
	Female	18	45,0	45,0	50,0
	Male	20	50,0	50,0	100,0
	Total	40	100,0	100,0	

Academic Career

Academic Career

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Master's Degree	4	10,0	10,0	10,0
	2 Master's Degree	3	7,5	7,5	17,5
	2 Bachelor's Degree	8	20,0	20,0	37,5
	3 Bachelor's Degree	5	12,5	12,5	50,0
	Master's Degree - Out of Course	1	2,5	2,5	52,5
	Bachelor's Degree - Out of Course	19	47,5	47,5	100,0
	Total	40	100,0	100,0	

Academic Career

- 1 Master's Degree
- 2 Master's Degree
- 2 Bachelor's Degree
- 3 Bachelor's Degree
- Master's Degree - Out of Course
- Bachelor's Degree - Out of Course
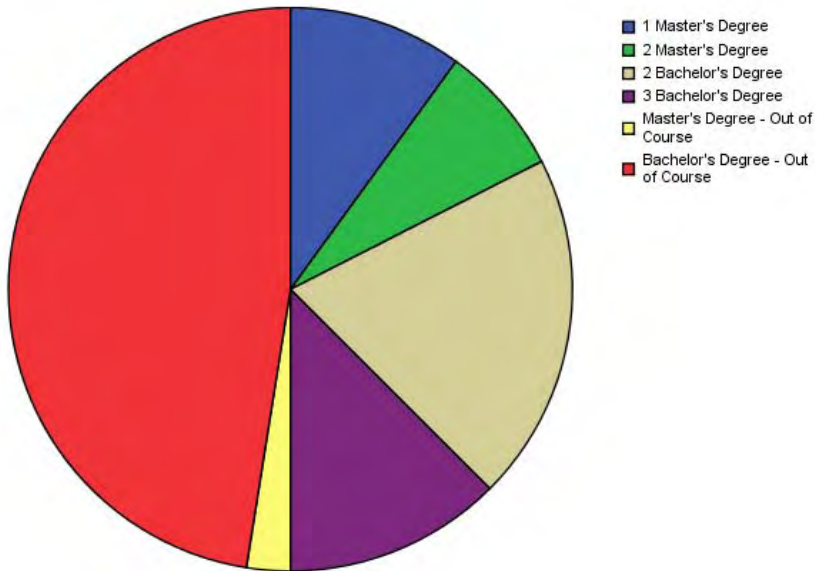
Athletic Discipline

Athletic Discipline

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	10,0	10,0	10,0
	Individual	18	45,0	45,0	55,0
	both	2	5,0	5,0	60,0
	Team Sport	16	40,0	40,0	100,0
	Total	40	100,0	100,0	

Athletic Discipline

Legend:
- Individual
- both
- Team Sport
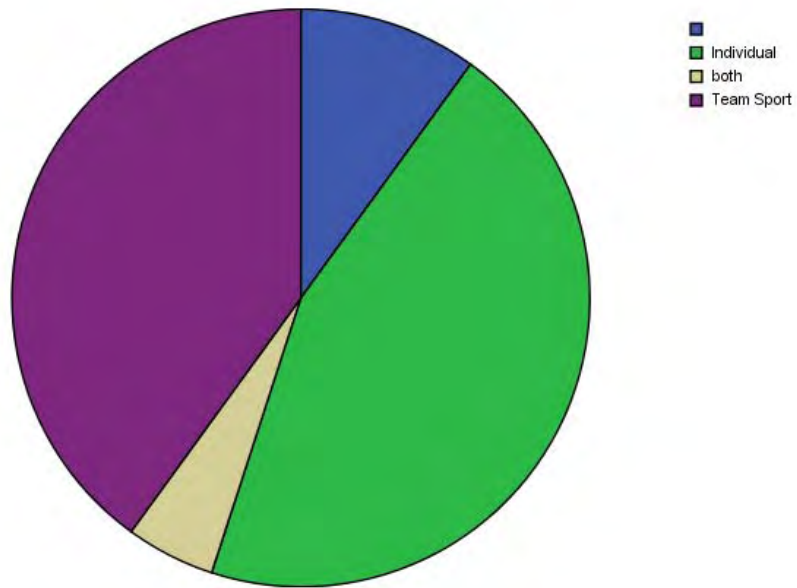
Video and Information Technology Skills

Video & IT Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	1	2,5	2,6	2,6
	Bad	6	15,0	15,4	17,9
	Sufficient	12	30,0	30,8	48,7
	Good	19	47,5	48,7	97,4
	Excellent	1	2,5	2,6	100,0
	Total	39	97,5	100,0	
Missing	System	1	2,5		
Total		40	100,0		

Video & IT Skills
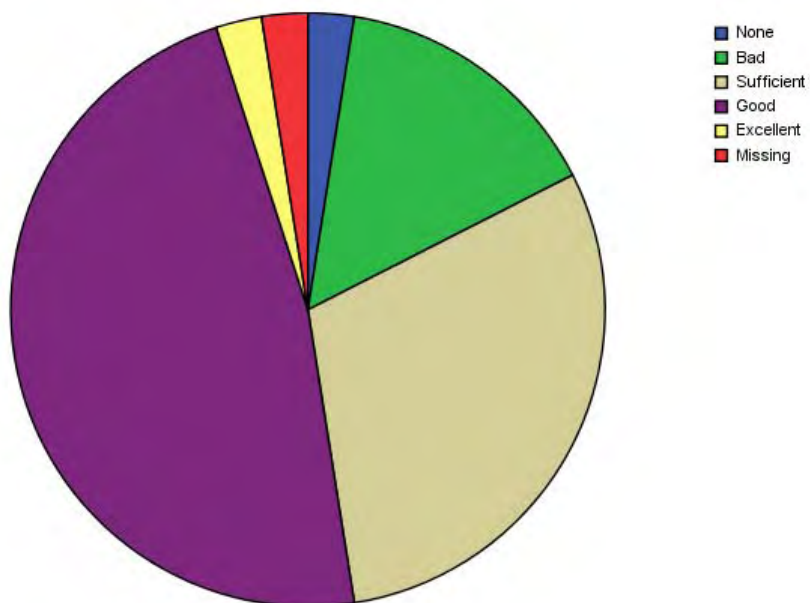
Statistics and Mathematical Skills

Math and Stat Skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	9	22,5	23,1	23,1
	Sufficient	19	47,5	48,7	71,8
	Good	11	27,5	28,2	100,0
	Total	39	97,5	100,0	
Missing	System	1	2,5		
Total		40	100,0		

Math and Stat Skills

■ Bad
■ Sufficient
□ Good
■ Missing
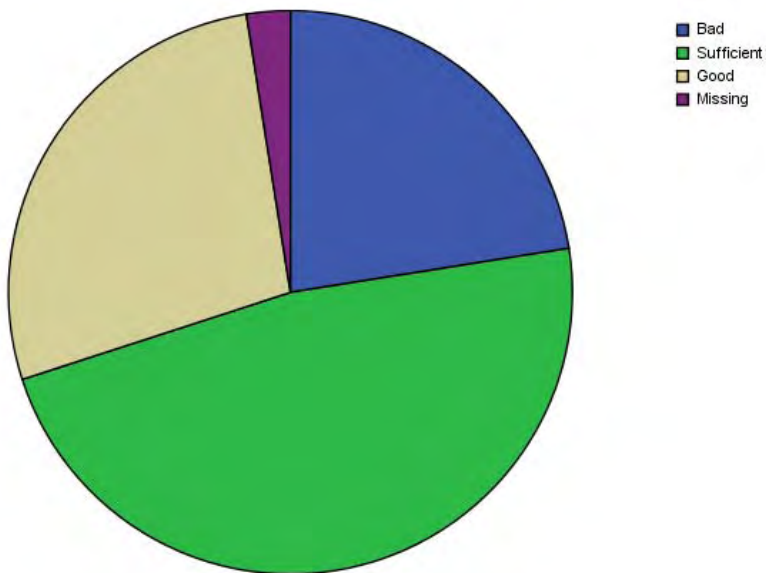
Knowledge of the professional profiles active in sport environments

Knowledge of Sport Profiles

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	2	5,0	5,3	5,3
	Sufficient	17	42,5	44,7	50,0
	Good	16	40,0	42,1	92,1
	Excellent	3	7,5	7,9	100,0
	Total	38	95,0	100,0	
Missing	System	2	5,0		
Total		40	100,0		

Knowledge of Sport Profiles

Bad
Sufficient
Good
Excellent
Missing
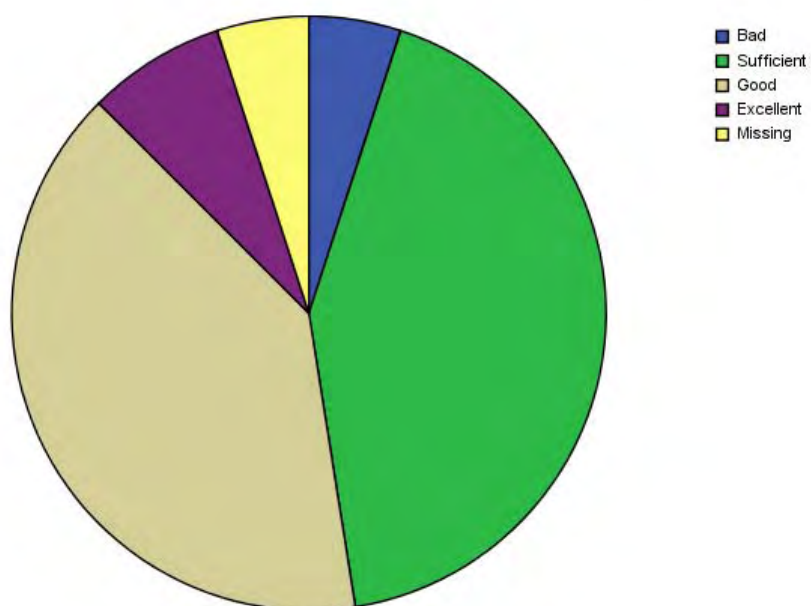
Knowledge of the MATCH ANALYSIS issues

Knowledge of MA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	4	10,0	10,5	10,5
	Bad	16	40,0	42,1	52,6
	Sufficient	11	27,5	28,9	81,6
	Good	7	17,5	18,4	100,0
	Total	38	95,0	100,0	
Missing	System	2	5,0		
Total		40	100,0		

Knowledge of MA
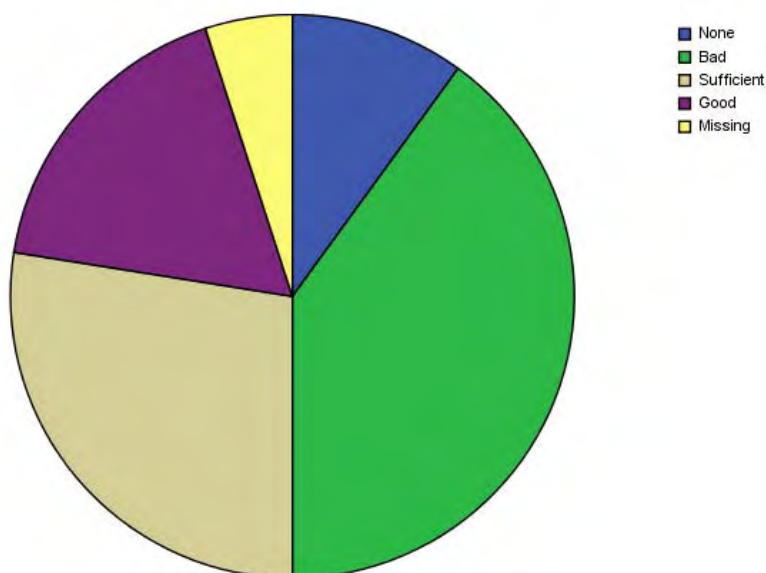
A general comment on the composition of the sample (Bio Data) and the Self Evaluation paragraph.

The sample is composed equally of **male** and **female** students with an average age of **25.27** (SD ± 5.33). The majority of the sample (47,5%) is represented by Bachelor Students still not graduated after the completion of their three-years Academic Course. The students declared to be practicing or to have practiced **Individual Sport** (45%) and **Team Sports** (40%).

In the **Self Evaluation** paragraph, we underline that the vast majority of the students assessed themselves as having **Sufficient** (30.8%) and **Good** (48.7%) skills about **Video and Information Technology**. They declared to have **Bad** (23.1%) or only **Sufficient** (48.7) Statistic and Mathematical skills. The declared knowledge of the professional profiles active in sport environments witnesses of a certain experience in this specific world: **Sufficient** (44.7%), **Good** (42.1%) and **Excellent** (7.9%) knowledge. About the specific issue of this research, the Match Analysis methodology, the studied sample seems to have a limited experience, whereas the declared knowledge is **None** (10.5%), **Bad** (42.1%) or **Sufficient** (28.9%). The different Mean displayed on this issue by the Master's Degree Students vs. the Bachelor's ones (M=3 vs M=2.3) could be explained by the implementation of some classes of Match Analysis in Team Sports during the second semester of the Master's Degree course.

11.5.6.1. Item 1

1) **Match Analysis in Team Sports is a constantly growing methodology.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	neither agree nor disagree	6	15,0	15,0	15,0
	agree	26	65,0	65,0	80,0
	strongly agree	8	20,0	20,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 1

N	Valid	40
	Missing	0
Mean		4,0500
Median		4,0000
Mode		4,00
Std. Deviation		,59700
Range		2,00
Minimum		3,00
Maximum		5,00
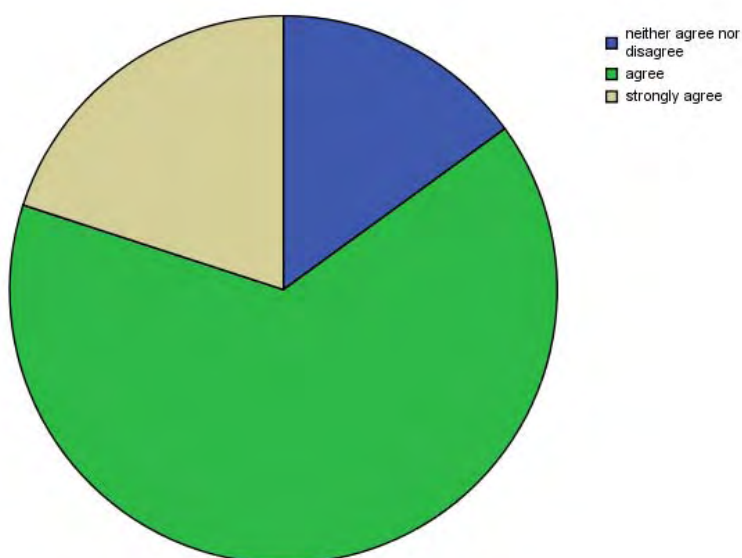
Item 1

Comment

Through this item we investigated the perception of the students, referring to the

possible evolution of the Match Analysis methodology.

We underline the cumulative percentage of **85%** that occurred as choice n.4) and 5),

which witnessed for a perceived **great importance** of this issue in modern sport.

The Chi-Square Value indicates a significant difference in the frequencies found.

Thus we can exclude the Null Hypothesis.

Item 1

	Observed N	Expected N	Residual
neither agree nor disagree	6	13,3	-7,3
agree	26	13,3	12,7
strongly agree	8	13,3	-5,3
Total	40		

Test Statistics

	Item 1
Chi-Square[a]	18,200
df	2
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than
5. The minimum expected cell frequency is 13,3.

T-Tests were performed in order to find possible significant differences between students regularly attending their classes (In corso) and those ones who are completing their courses in a longer time (Fuori Corso).

No significant differences were found.

One-Sample Test

Corso/Fuori Corso		Test Value = 4.05				95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
In corso	Item 1	,349	19	,731	,05000	-,2499	,3499
Fuori corso	Item 1	-,398	19	,695	-,05000	-,3130	,2130

11.5.6.2. Item 2

2) **The value of the Match Analyst professional profile is widely appreciated throughout the sport world.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	9	22,5	23,1	23,1
	neither agree nor disagree	12	30,0	30,8	53,8
	agree	17	42,5	43,6	97,4
	strongly agree	1	2,5	2,6	100,0
	Total	39	97,5	100,0	
Missing	System	1	2,5		
Total		40	100,0		

Statistics

Item 2

N	Valid	39
	Missing	1
Mean		3,2564
Median		3,0000
Mode		4,00
Std. Deviation		,84970
Range		3,00
Minimum		2,00
Maximum		5,00
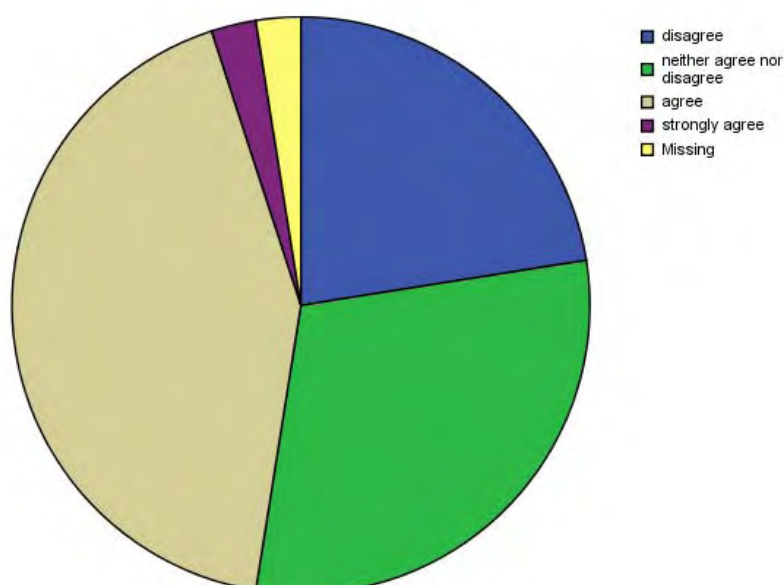
Item 2

Comment

Through this item we investigated the perception of the students, referring to the relevance of the Match Analyst professional profile.

The students presented a dual attitude.. Almost the 50% of the sample seems to consider this professional profile underestimated within the sport world (choices n. 1, 2 and partially 3), whereas the other part of the sample (choices 4 and 5) displayed a perception of **good appreciation** of the Match Analyst.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 2

	Observed N	Expected N	Residual
disagree	9	9,8	-,8
neither agree nor disagree	12	9,8	2,3
agree	17	9,8	7,3
strongly agree	1	9,8	-8,8
Total	39		

Test Statistics

	Item 2
Chi-Square[a]	13,821
df	3
Asymp. Sig.	,003

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 9,8.

11.5.9. Item 3

3) It is not necessary a specific training to work as Match Analyst.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	12	30,0	30,0	30,0
	disagree	22	55,0	55,0	85,0
	neither agree nor disagree	4	10,0	10,0	95,0
	agree	2	5,0	5,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 3

N	Valid	40
	Missing	0
Mean		1,9000
Median		2,0000
Mode		2,00
Std. Deviation		,77790
Range		3,00
Minimum		1,00
Maximum		4,00
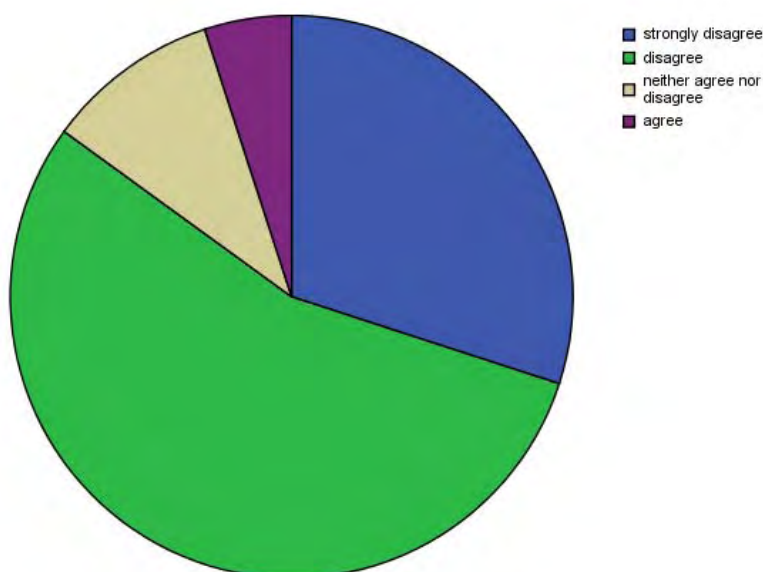
Comment

Through this item we investigated the perception of the students, referring to the required training of a Match Analyst.

We underline the cumulative percentage of 85% that occurred as choice n.1) and 2), which witnessed for a perceived **great importance** of a specific training and education for this professional profile.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 3

	Observed N	Expected N	Residual
strongly disagree	12	10,0	2,0
disagree	22	10,0	12,0
neither agree nor disagree	4	10,0	-6,0
agree	2	10,0	-8,0
Total	40		

Test Statistics

	Item 3
Chi-Square[a]	24,800
df	3
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.10.   Item 4

4)   Match Analysis has no role in the context of Youth Sport.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	7	17,5	17,5	17,5
	disagree	19	47,5	47,5	65,0
	neither agree nor disagree	10	25,0	25,0	90,0
	agree	2	5,0	5,0	95,0
	strongly agree	2	5,0	5,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 4

N	Valid	40
	Missing	0
Mean		2,3250
Median		2,0000
Mode		2,00
Std. Deviation		,99711
Range		4,00
Minimum		1,00
Maximum		5,00
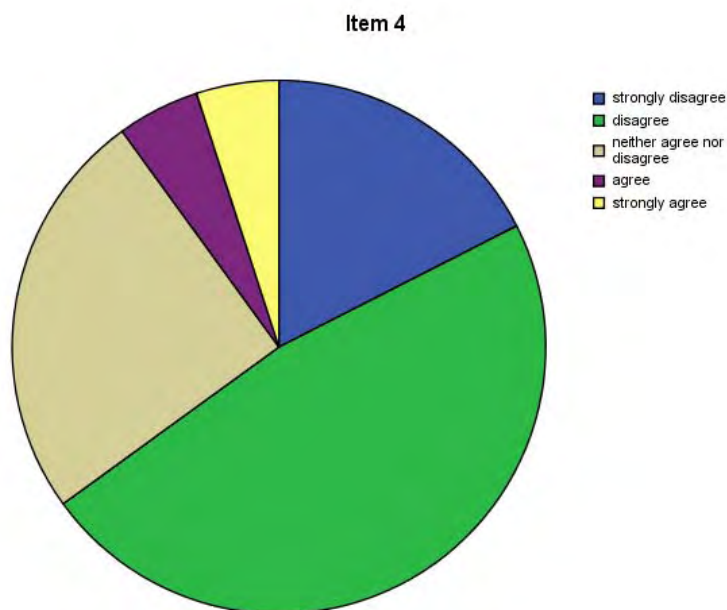
Item 4

Comment

Through this item we investigated the perception of the students, referring to the relevance of the Match Analysis processes in the context of Youth Sport.

We underline the cumulative percentage of 65% that occurred as choice n.1) and 2), which witnessed for a perceived **great importance** of a systematic process of Match Analysis within the Youth Sport context.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 4

	Observed N	Expected N	Residual
strongly disagree	7	8,0	-1,0
disagree	19	8,0	11,0
neither agree nor disagree	10	8,0	2,0
agree	2	8,0	-6,0
strongly agree	2	8,0	-6,0
Total	40		

Test Statistics

	Item 4
Chi-Square[a]	24,750
df	4
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 8,0.

11.5.11. Item 5

5) **In modern Team Sports, the Coaching Staff working as a unit is crucial issue: the Coach on his own will never be able to manage properly all the complexities of training and coaching a team, without the help of highly trained personnel.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2,5	2,5	2,5
	neither agree nor disagree	2	5,0	5,0	7,5
	agree	17	42,5	42,5	50,0
	strongly agree	20	50,0	50,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 5

N	Valid	40
	Missing	0
Mean		4,4000
Median		4,5000
Mode		5,00
Std. Deviation		,70892
Range		3,00
Minimum		2,00
Maximum		5,00
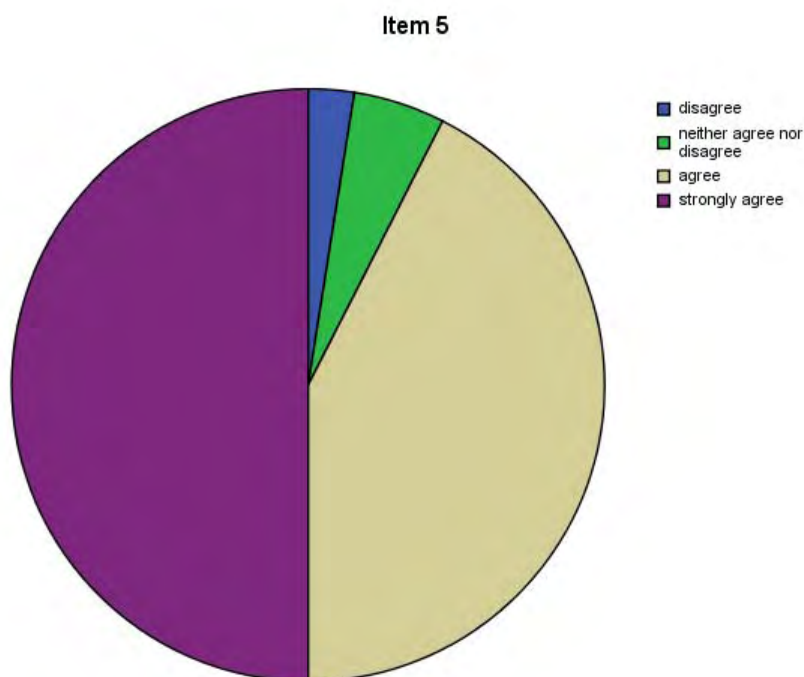
Item 5

Comment

Through this item we investigated the perception of the students, referring to the relevance of the Match Analysis processes in the context of a Coaching Staff, working as a Team Unit.

We underline the cumulative percentage of 92.5% that occurred as choice n.4) and 5), which witnessed for a perceived **great importance** of a systematic process of Match Analysis within the modern Sport world, carried out by highly qualified personnel.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 5

	Observed N	Expected N	Residual
disagree	1	10,0	-9,0
neither agree nor disagree	2	10,0	-8,0
agree	17	10,0	7,0
strongly agree	20	10,0	10,0
Total	40		

Test Statistics

	Item 5
Chi-Square[a]	29,400
df	3
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.12.   Item 6

6) **The Match Analyst greatly contributes in order to train and coach a High Performance Team, together with other professional profiles (the Coach, the Fitness Trainer, the Assistant Coaches, the Medical Doctors, the Psychologist, the Physio, etc.)**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	neither agree nor disagree	4	10,0	10,3	10,3
	agree	22	55,0	56,4	66,7
	strongly agree	13	32,5	33,3	100,0
	Total	39	97,5	100,0	
Missing	System	1	2,5		
Total		40	100,0		

Statistics

Item 6

N	Valid	39
	Missing	1
Mean		4,2308
Median		4,0000
Mode		4,00
Std. Deviation		,62667
Range		2,00
Minimum		3,00
Maximum		5,00

Item 6
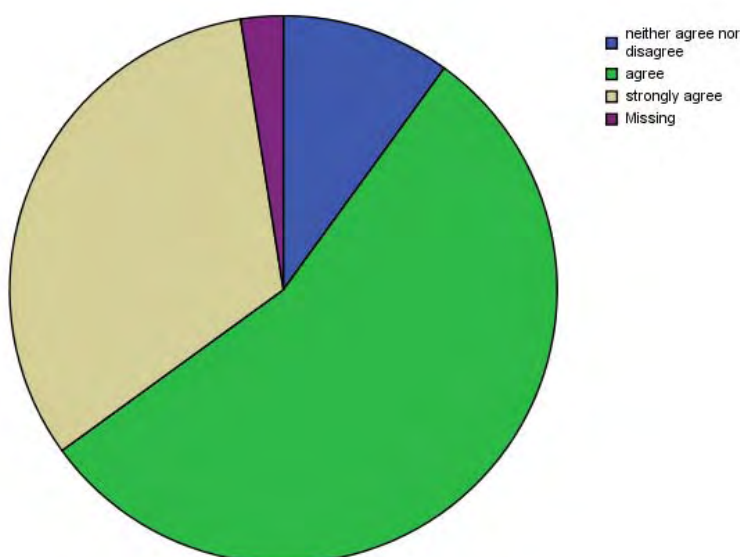
Comment

As in Item 5) through this item we investigated the perception of the students, referring to the relevance of the Match Analysis processes in the context of a Coaching Staff, working as a Team Unit.

We underline the cumulative percentage of 89.7% that occurred as choice n.4) and 5), which witnessed for a perceived **great importance** of a systematic process of Match Analysis within the modern Sport world, carried out by highly qualified personnel together with other important system figures.

The Chi-Square Value indicates a significant difference in the frequencies found.

Thus we can exclude the Null Hypothesis.

Item 6

	Observed N	Expected N	Residual
neither agree nor disagree	4	13,0	-9,0
agree	22	13,0	9,0
strongly agree	13	13,0	,0
Total	39		

Test Statistics

	Item 6
Chi-Square[a]	12,462
df	2
Asymp. Sig.	,002

[a.] 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 13,0.

11.5.13.   Item 7

7)   The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own experience.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	6	15,0	15,0	15,0
	disagree	16	40,0	40,0	55,0
	neither agree nor disagree	16	40,0	40,0	95,0
	agree	2	5,0	5,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 7

N	Valid	40
	Missing	0
Mean		2,3500
Median		2,0000
Mode		2,00a
Std. Deviation		,80224
Range		3,00
Minimum		1,00
Maximum		4,00

a. Multiple modes exist. The smallest value is shown

Item 7
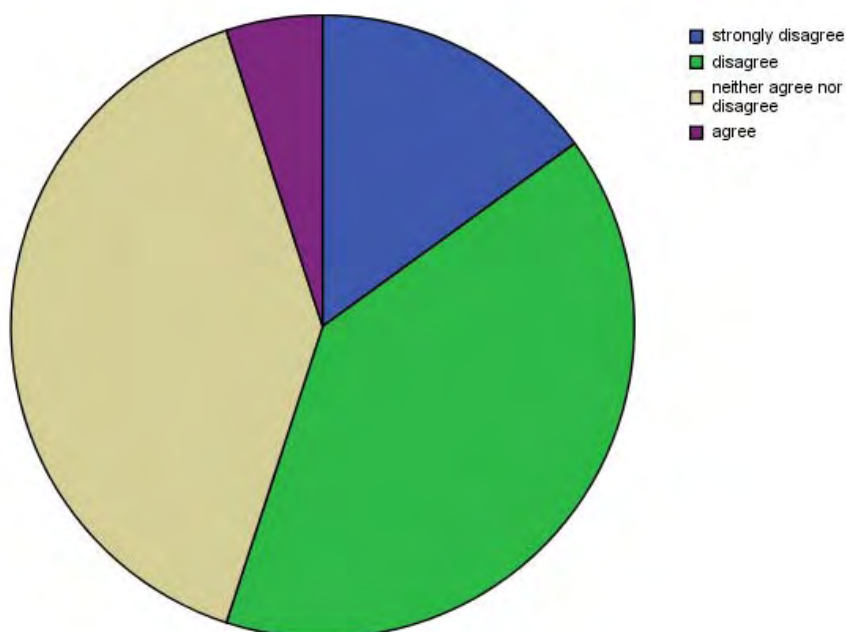
Comment

Through this item we investigated the perception of the students referring to the profile of the Coach and his skills in analysing his and the opposing team, through his own experience.

We underline the cumulative percentage of 55.5% that occurred as choice n.1) and 2), which witnessed the need of a systematic process of Match Analysis carried out

by highly qualified personnel, working as a team or coaching staff. It is noteworthy the percentage of 40% of the sample which chose the answer n. 3 (neither agree nor disagree), witnessing a certain not clear vision about this specific issue.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 7

	Observed N	Expected N	Residual
strongly disagree	6	10,0	-4,0
disagree	16	10,0	6,0
neither agree nor disagree	16	10,0	6,0
agree	2	10,0	-8,0
Total	40		

Test Statistics

	Item 7
Chi-Square[a]	15,200
df	3
Asymp. Sig.	,002

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.14. Item 8

8) **The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own observational and mnemonic skills.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	5	12,5	12,5	12,5
	disagree	18	45,0	45,0	57,5
	neither agree nor disagree	14	35,0	35,0	92,5
	agree	3	7,5	7,5	100,0
	Total	40	100,0	100,0	

Statistics

Item 8

N	Valid	40
	Missing	0
Mean		2,3750
Median		2,0000
Mode		2,00
Std. Deviation		,80662
Range		3,00
Minimum		1,00
Maximum		4,00

Item 8
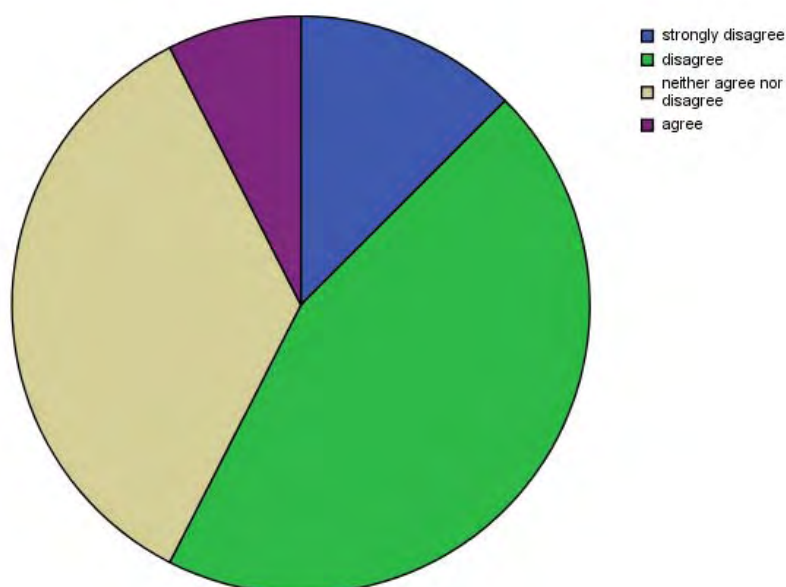
Comment

As in item 7) through this item we investigated the perception of the students referring to the profile of the Coach and his skills in analysing his and the opposing team, through his observational and mnemonic skills.

We underline the cumulative percentage of 57.5% that occurred as choice n.1) and 2), which witnessed the need of a systematic process of Match Analysis carried out by highly qualified personnel, working as a team or coaching staff. It is noteworthy the percentage of 35% of the sample which chose the answer n. 3 (neither agree nor disagree), witnessing again a certain not clear vision about this specific issue.

313

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 8

	Observed N	Expected N	Residual
strongly disagree	5	10,0	-5,0
disagree	18	10,0	8,0
neither agree nor disagree	14	10,0	4,0
agree	3	10,0	-7,0
Total	40		

Test Statistics

	Item 8
Chi-Square[a]	15,400
df	3
Asymp. Sig.	,002

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.15.   Item 9

9) The number of people of the Coaching Staff dedicated to the Match Analysis procedures should be:

a) None   ◊
b) 1   ◊
c) 2   ◊
d) 3   ◊
e) More than 3   ◊

(please, just one answer)

Item 9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	2,5	2,5	2,5
	1	9	22,5	22,5	25,0
	2	15	37,5	37,5	62,5
	3	7	17,5	17,5	80,0
	more than 3	8	20,0	20,0	100,0
	Total	40	100,0	100,0	

Item 9
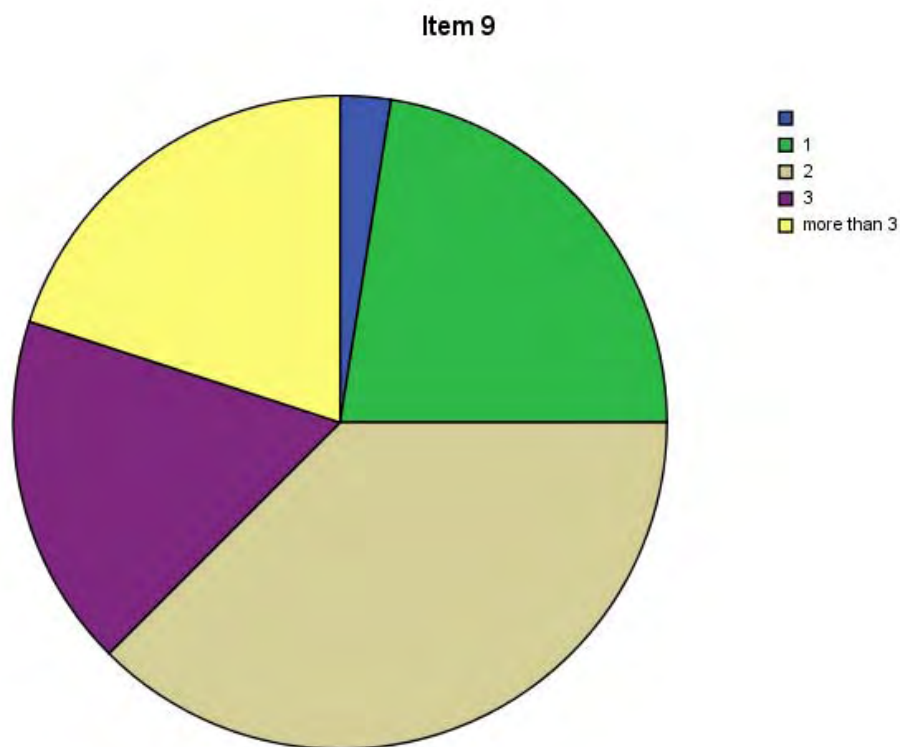
Comment

Through this item we investigated the perception of the quantitative dimension of the M.A. procedures required within a coaching staff. It is interesting to note that a 37.5% of the sample considered 2 persons necessary to work on this specific issue.

11.5.16.   Item 10

10)   **A Top Level Technology is definitely required in order to provide the Match Analysis procedures suitable to high level Team Sports.**

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	5	12,5	12,8	12,8
	neither agree nor disagree	12	30,0	30,8	43,6
	agree	19	47,5	48,7	92,3
	strongly agree	3	7,5	7,7	100,0
	Total	39	97,5	100,0	
Missing	System	1	2,5		
Total		40	100,0		

Statistics

Item 10

N	Valid	39
	Missing	1
Mean		3,5128
Median		4,0000
Mode		4,00
Std. Deviation		,82308
Range		3,00
Minimum		2,00
Maximum		5,00
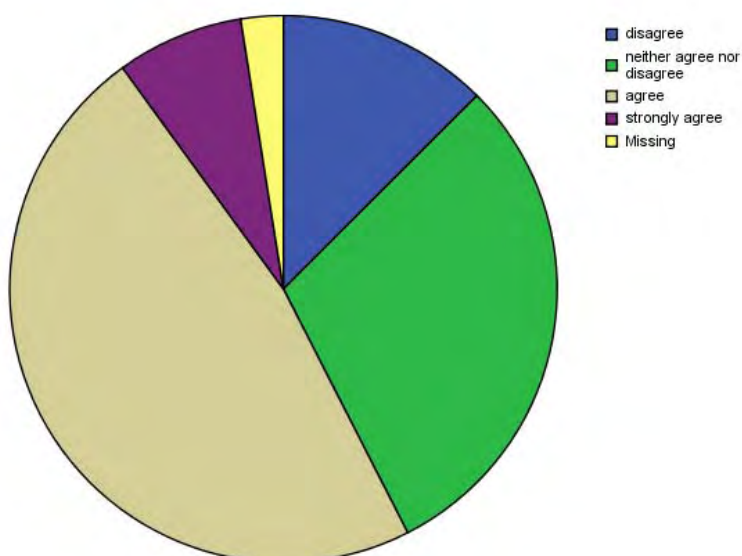
316

Comment

Through this item we investigated the perception of the students referring to the technology required to be able to provide effective Match Analysis in top Team Sports.

We underline the cumulative percentage of 56.4% that occurred as choice n.4) and 5), which witnessed the perceived need of top level technology in order to grant effective Match Analysis procedures. It is clearly related to the need of specific training and the availability of the relevant supplies and or devices. It is anyway noteworthy the percentage of 30.8% of the sample which chose the answer n. 3 (neither agree nor disagree), witnessing the attitude of an important part of the sample regarding the possibility to be efficiently operative even without up-to-date or top level devices.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 10

	Observed N	Expected N	Residual
disagree	5	9,8	-4,8
neither agree nor disagree	12	9,8	2,3
agree	19	9,8	9,3
strongly agree	3	9,8	-6,8
Total	39		

Test Statistics

	Item 10
Chi-Square[a]	16,282
df	3
Asymp. Sig.	,001

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 9,8.

317

11.5.17.   Item 11

11) Match Analysis is just a moment fashion. It will go probably out of style sooner…

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	10	25,0	25,0	25,0
	disagree	23	57,5	57,5	82,5
	neither agree nor disagree	5	12,5	12,5	95,0
	agree	2	5,0	5,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 11

N	Valid	40
	Missing	0
Mean		1,9750
Median		2,0000
Mode		2,00
Std. Deviation		,76753
Range		3,00
Minimum		1,00
Maximum		4,00

Item 11
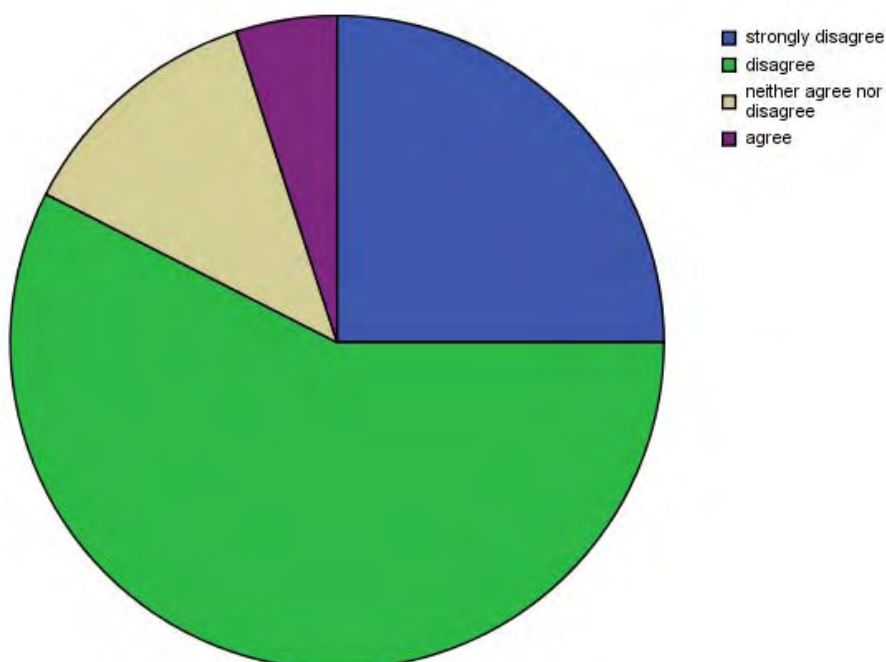
318

Comment

Through this item we investigated the perception of the students referring to the consistency of the Match Analysis process in the context of the current sport world. We underline the cumulative percentage of 82.5% that occurred as choice n.1) and 2), which witnessed the perceived consistency of this methodology, also confirming what has been expressed in item 1).

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 11

	Observed N	Expected N	Residual
strongly disagree	10	10,0	,0
disagree	23	10,0	13,0
neither agree nor disagree	5	10,0	-5,0
agree	2	10,0	-8,0
Total	40		

Test Statistics

	Item 11
Chi-Square[a]	25,800
df	3
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.18. Item 12

12) I consider useful the organization of a specific Training Course for Match Analysts.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2,5	2,5	2,5
	neither agree nor disagree	3	7,5	7,5	10,0
	agree	28	70,0	70,0	80,0
	strongly agree	8	20,0	20,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 12

N	Valid	40
	Missing	0
Mean		4,0750
Median		4,0000
Mode		4,00
Std. Deviation		,61550
Range		3,00
Minimum		2,00
Maximum		5,00

Item 12
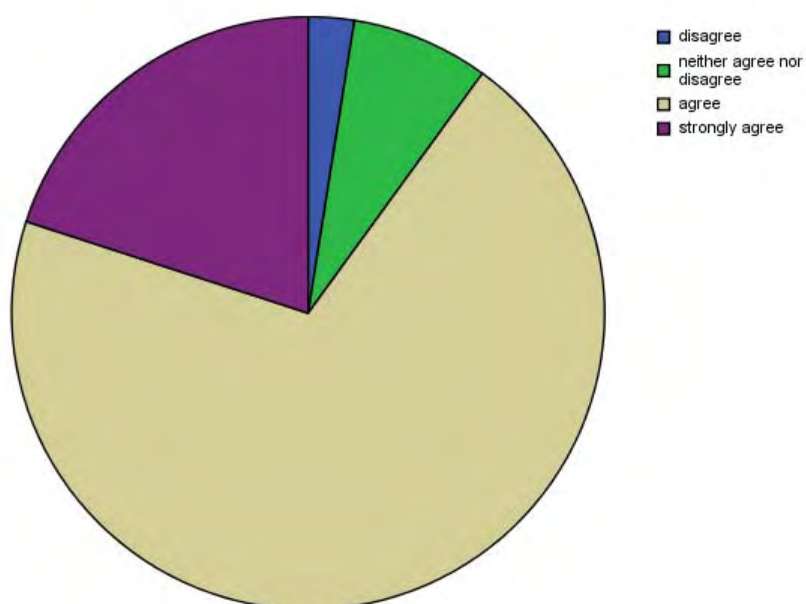
320

Comment

Through this item we investigated the perception of the students referring to the need of a specific training course in order to qualify the Match Analysts.

We underline the cumulative percentage of 90% that occurred as choice n.4) and 5), which witnessed for the perceived **great importance** about this issue, confirming a positive attitude of the students to this matter.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 12

	Observed N	Expected N	Residual
disagree	1	10,0	-9,0
neither agree nor disagree	3	10,0	-7,0
agree	28	10,0	18,0
strongly agree	8	10,0	-2,0
Total	40		

Test Statistics

	Item 12
Chi-Square[a]	45,800
df	3
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.19.   Item 13

13) This Training Course should be organized by Sport Federations and by the National Olympic Committee.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	2	5,0	5,0	5,0
	disagree	13	32,5	32,5	37,5
	neither agree nor disagree	11	27,5	27,5	65,0
	agree	12	30,0	30,0	95,0
	strongly agree	2	5,0	5,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 13

N	Valid	40
	Missing	0
Mean		2,9750
Median		3,0000
Mode		2,00
Std. Deviation		1,02501
Range		4,00
Minimum		1,00
Maximum		5,00

Item 13
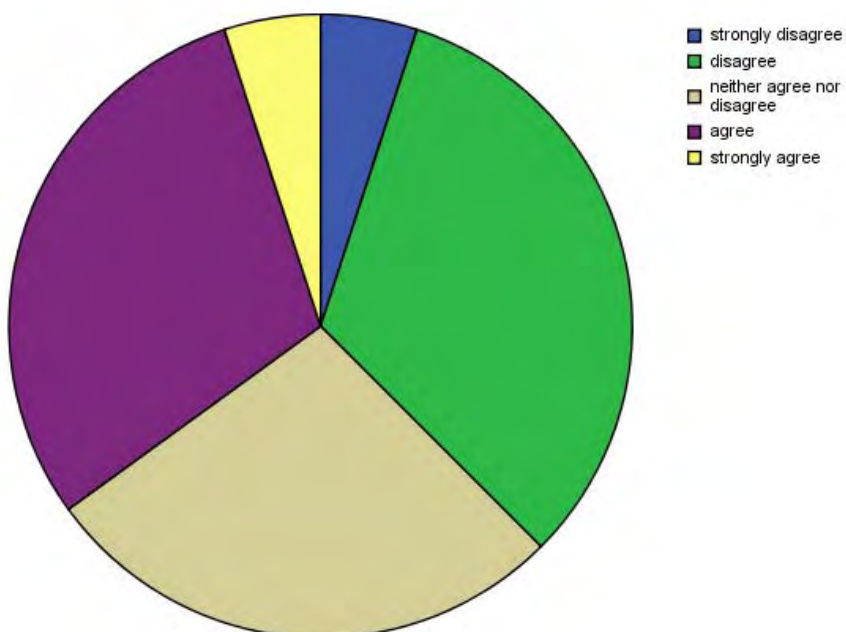
322

Comment

Through this item we investigated the perception and the attitude of the students about the educative agency felt as responsible of organising training courses for Match Analysts.

There is not a clear and unambiguous vision about that: about 37% of the students does not agree with this proposal while about 35% agreed with a training course organized by Sport Federations or the National Olympic Committee. Other students (27.5%) seem not to be clearly orientated.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 13

	Observed N	Expected N	Residual
strongly disagree	2	8,0	-6,0
disagree	13	8,0	5,0
neither agree nor disagree	11	8,0	3,0
agree	12	8,0	4,0
strongly agree	2	8,0	-6,0
Total	40		

Test Statistics

	Item 13
Chi-Square[a]	15,250
df	4
Asymp. Sig.	,004

[a.] 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 8,0.

11.5.20. Item 14

14) This Training Course should be organized by the Sport Sciences Universities.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	neither agree nor disagree	5	12,5	12,5	12,5
	agree	19	47,5	47,5	60,0
	strongly agree	16	40,0	40,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 14

N	Valid	40
	Missing	0
Mean		4,2750
Median		4,0000
Mode		4,00
Std. Deviation		,67889
Range		2,00
Minimum		3,00
Maximum		5,00

Item 14

324
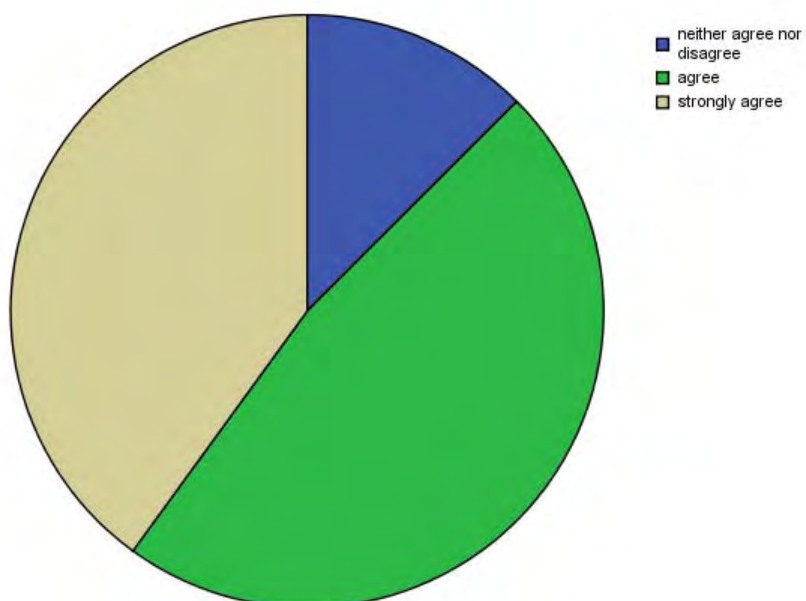
Comment

Through this item we investigated again the perception and the attitude of the students about the educative agency felt as responsible of organising training courses for Match Analysts.

Differently from what found in Item 13) the students showed a strong orientation (87.5%) in confirming the University as the proper agency possibly responsible for such a training course.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 14

	Observed N	Expected N	Residual
neither agree nor disagree	5	13,3	-8,3
agree	19	13,3	5,7
strongly agree	16	13,3	2,7
Total	40		

Test Statistics

	Item 14
Chi-Square[a]	8,150
df	2
Asymp. Sig.	,017

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 13,3.

11.5.21.　Item 15

15) I consider this Professional Profile really interesting and I would like to attend a specific Training Course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	4	10,0	10,0	10,0
	neither agree nor disagree	7	17,5	17,5	27,5
	agree	21	52,5	52,5	80,0
	strongly agree	8	20,0	20,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 15

N	Valid	40
	Missing	0
Mean		3,8250
Median		4,0000
Mode		4,00
Std. Deviation		,87376
Range		3,00
Minimum		2,00
Maximum		5,00

Item 15
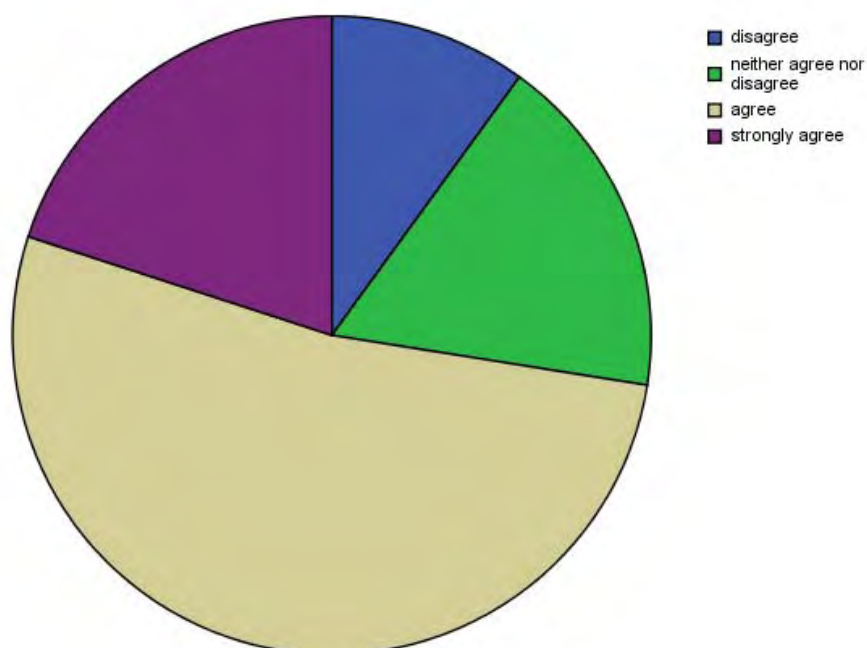
Comment

Through this item we investigated the perception and the attitude of the students about their possible personal involvement in attending a specific course aimed to qualify Match Analysts.

The cumulative percentage (72.5%) of choice 4) and 5) witnesses for a strong positive attitude towards this issue, underlining a possible good possibility of organising such training course.

We can consider this item as a crucial one in the whole context of this research.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 15

	Observed N	Expected N	Residual
disagree	4	10,0	-6,0
neither agree nor disagree	7	10,0	-3,0
agree	21	10,0	11,0
strongly agree	8	10,0	-2,0
Total	40		

Test Statistics

	Item 15
Chi-Square[a]	17,000
df	3
Asymp. Sig.	,001

[a.] 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.22.   Item 16

16) This Course should be designed with an amount of education time suitable to qualify highly trained personnel.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	disagree	1	2,5	2,5	2,5
	neither agree nor disagree	4	10,0	10,0	12,5
	agree	27	67,5	67,5	80,0
	strongly agree	8	20,0	20,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 16

N	Valid	40
	Missing	0
Mean		4,0500
Median		4,0000
Mode		4,00
Std. Deviation		,63851
Range		3,00
Minimum		2,00
Maximum		5,00

Item 16
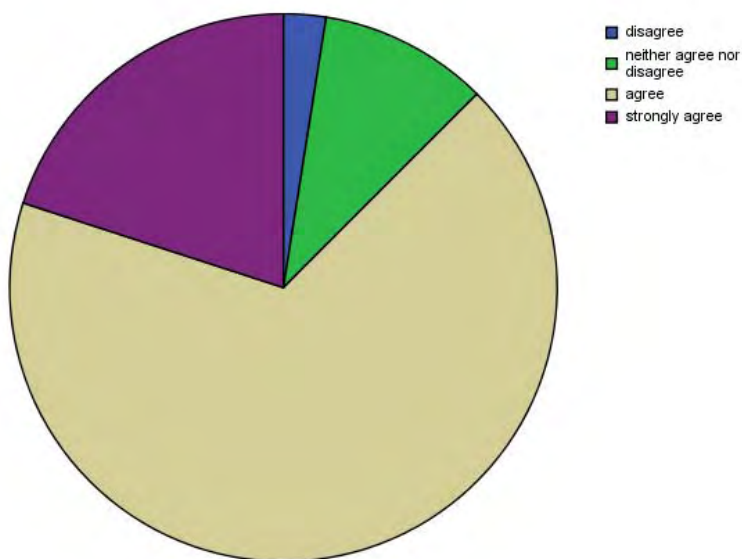
Comment

Through this item we investigated the perception and the attitude of the students about their possible personal involvement in attending a specific course aimed to qualify Match Analysts. In this case we tested their pragmatic inclination to attend a course coherent with highly qualification criteria, under the temporal point of view.

The cumulative percentage (87.5%) of choice 4) and 5) witnesses for a strong positive attitude towards this issue, underlining the need of designing a training course able to match these expectations.

Again, we can consider this item as a crucial one in the whole context of this research.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 16

	Observed N	Expected N	Residual
disagree	1	10,0	-9,0
neither agree nor disagree	4	10,0	-6,0
agree	27	10,0	17,0
strongly agree	8	10,0	-2,0
Total	40		

Test Statistics

	Item 16
Chi-Square[a]	41,000
df	3
Asymp. Sig.	,000

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 10,0.

11.5.23. Item 17

17) I think appropriate for such a Course an amount of time of:

a. Less than 50 hours   ◊
b. 50-100 hours   ◊
c. 101-200 hours   ◊
d. 201-400 hours   ◊
e. More than 400 hours ◊

Item 17

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2,5	2,5	2,5
less than 50 hours	6	15,0	15,0	17,5
51-100 hrs.	14	35,0	35,0	52,5
101-200 hrs.	5	12,5	12,5	65,0
201-400 hrs.	11	27,5	27,5	92,5
more than 400 hrs.	3	7,5	7,5	100,0
Total	40	100,0	100,0	

Item 17
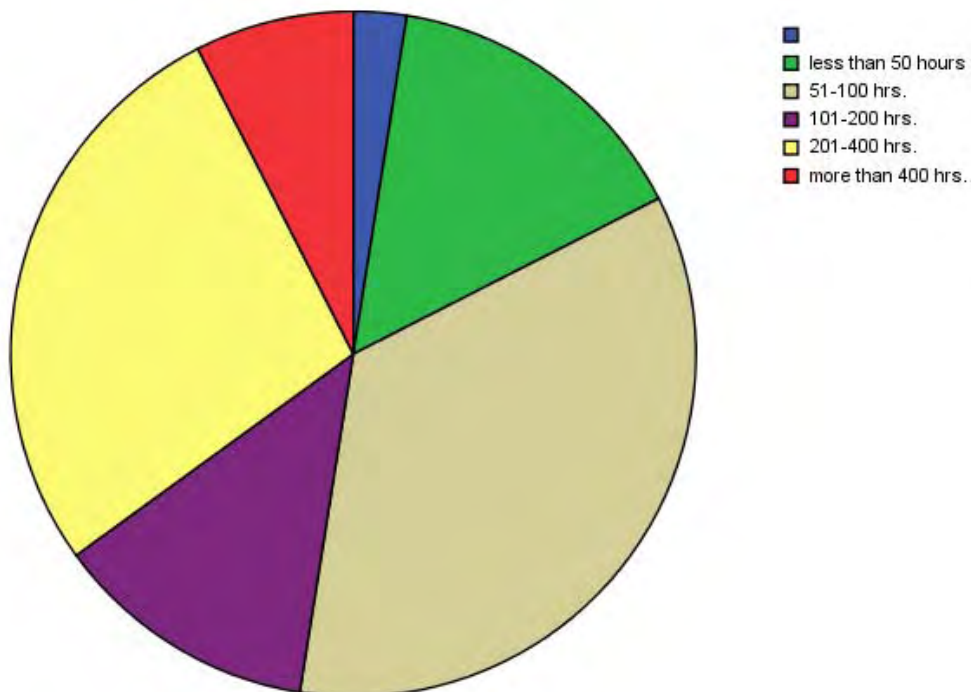
■
■ less than 50 hours
☐ 51-100 hrs.
■ 101-200 hrs.
☐ 201-400 hrs.
■ more than 400 hrs.

Comment

Through this item we investigated the perception and the attitude of the students about their possible personal involvement in attending a specific course aimed to qualify Match Analysts. In this case we tested their pragmatic inclination to attend a course coherent with highly qualification criteria, under the temporal point of view. The temporal dimensions felt as the most consistent with the demands of such training course are two:

- 51-100 hours (35%)

- 201-400 hours (27.5%)

11.5.24.   Item 18

18) This Training Course (for Match Analyst) should be designed at this level:

a.   Basic Sport Training Course (Sport Federations, Olympic Committee)   ◊
b.   Dedicated Class within the Sport Sciences Bachelor's Degree   ◊
c.   Dedicated Class within the Sport Sciences Master's Degree   ◊
d.   Italian Master, level 1   ◊
e.   Italian Master, level 2   ◊

Item 18

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Basic Sport Course	2	5,0	5,0	5,0
	Bachelor Level	14	35,0	35,0	40,0
	Master Level	15	37,5	37,5	77,5
	Italian Master 1°	8	20,0	20,0	97,5
	Italian Master 2°	1	2,5	2,5	100,0
	Total	40	100,0	100,0	
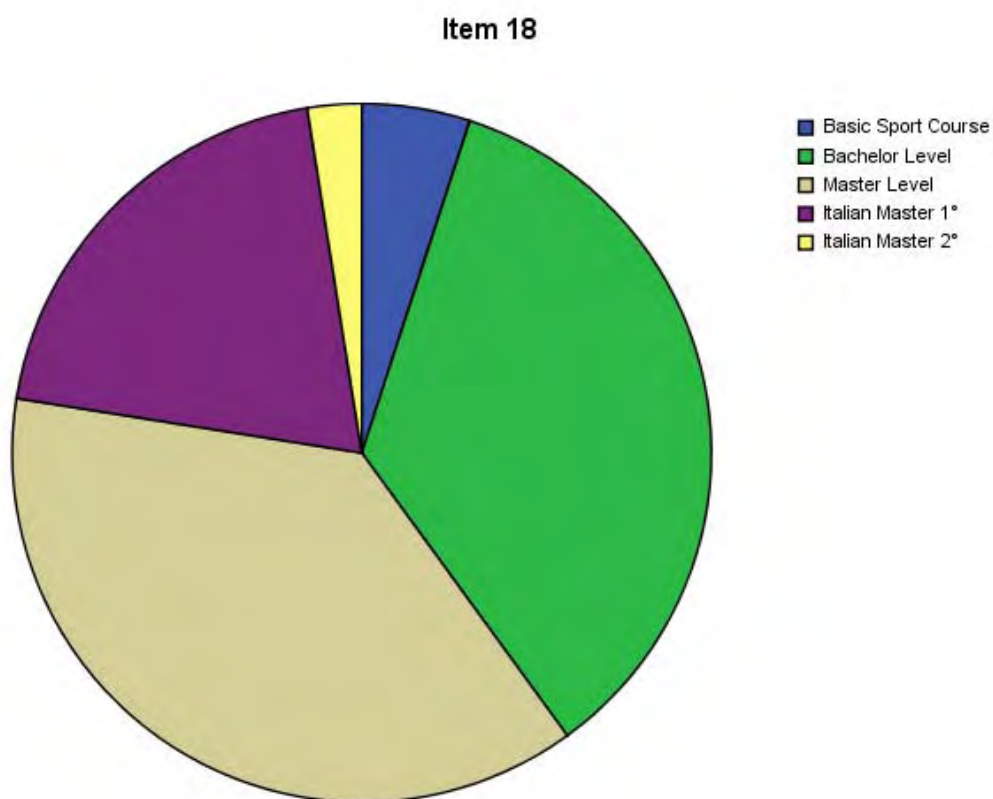
Item 18

Comment

Through this item we investigated the perception and the attitude of the students about their possible personal involvement in attending a specific course aimed at qualifying Match Analysts. In this case we tested at what different level of the university career, such training course should be implemented.

There are two main clusters, which basically equalize in dimension:

- 35% suggested a course at Bachelor level

- 37.5 suggested a course at Master level

11.5.25.   Item 19

19) In order to attend this Course, I would spend this amount of money:

a.   Less than €200   ◊

b.   €201-500   ◊
c.   €501-1.000   ◊
d.   €1.001-1.500   ◊
e.   €1.501-2.000   ◊

Item 19

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2,5	2,5	2,5
less than 200 €	18	45,0	45,0	47,5
201-500 €	11	27,5	27,5	75,0
501-1.000 €	8	20,0	20,0	95,0
1.001-1.500 €	1	2,5	2,5	97,5
1.501-2.000 €	1	2,5	2,5	100,0
Total	40	100,0	100,0	

Item 19
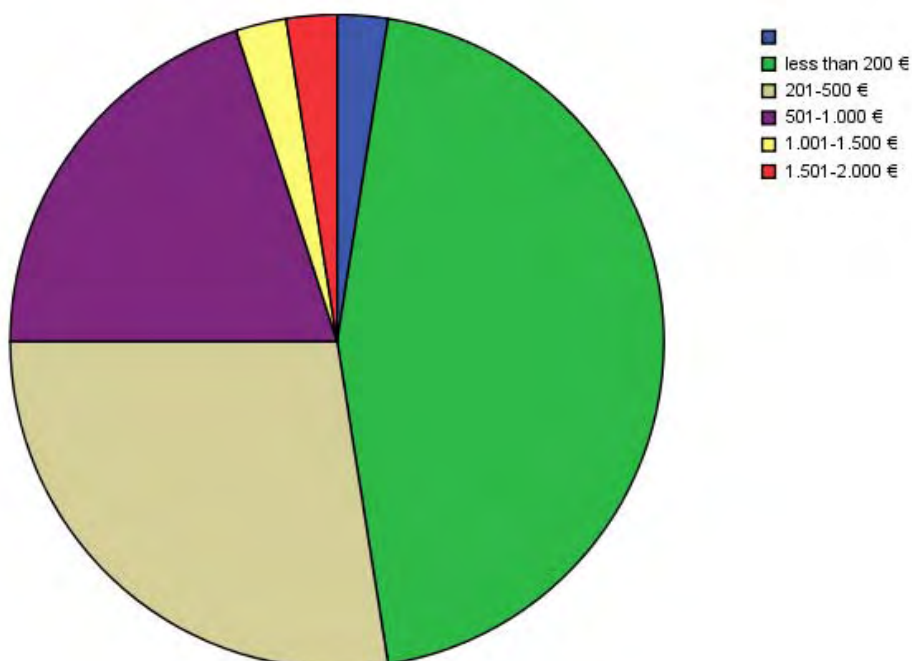
Comment

Through this item we investigated the perception and the attitude of the students about their possible personal involvement in attending a specific course aimed to qualify Match Analysts. In this case we tested what different level of economical personal exposure they would accept in order to attend such training course.

- 45% of the sample indicated a personal exposure of less than 200 €

- 27.5% of the sample indicated a personal exposure of 201-500 €

- 20% of the sample indicated a personal exposure of 501-1.000 €

11.5.26.   Item 20

20) I expect this specific education suitable to let me enter the top sport world as an highly qualified expert.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

Item 20

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	neither agree nor disagree	8	20,0	20,0	20,0
	agree	22	55,0	55,0	75,0
	strongly agree	10	25,0	25,0	100,0
	Total	40	100,0	100,0	

Statistics

Item 20

N	Valid	40
	Missing	0
Mean		4,0500
Median		4,0000
Mode		4,00
Std. Deviation		,67748
Range		2,00
Minimum		3,00
Maximum		5,00
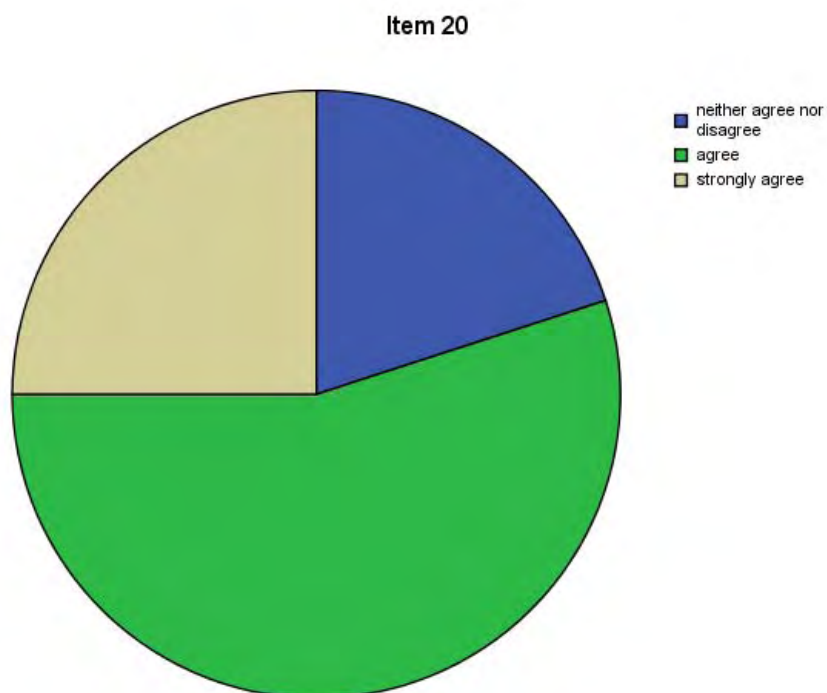
Item 20

Comment

Through this item we investigated the perception and the attitude of the students about their personal expectations about a possible involvement in attending a specific course aimed to qualify Match Analysts. The level of expectations seems to be very high, since the 80% of the sample believes that the participation to such a training course could be an important opportunity in order to achieve a chance to enter a top sport world, as an expert of this specific field.

The Chi-Square Value indicates a significant difference in the frequencies found. Thus we can exclude the Null Hypothesis.

Item 20

	Observed N	Expected N	Residual
neither agree nor disagree	8	13,3	-5,3
agree	22	13,3	8,7
strongly agree	10	13,3	-3,3
Total	40		

Test Statistics

	Item 20
Chi-Square[a]	8,600
df	2
Asymp. Sig.	,014

a. 0 cells (,0%) have expected frequencies less than 5. The minimum expected cell frequency is 13,3.

11.5.7.   Discussion

Match Analysis is a major issue among coaches, team managers and sport scientists. Information and information processes *(Hughes and Franks, 2004)* are the key factors while referring to this aspect of sport methodology.

The Match Analyst is a constantly increasing professional profile among the ones involved in Coaching Staff, mostly in Team Sports and it is gaining relevance day by day.

In order to investigate the possible labour market for this professional profile, we decided to design a questionnaire suitable to define the current attitudes of the people most likely to be involved in coaching staff, at every level: the Sport Sciences Students.

Through the questionnaire we submitted to the Sport Sciences Students, representing our sample, we investigated also the perceived need of such new professional profile and his possible training.

In order to **summarize** what we found in **Section 2)**, we can say that:

1. Match Analysis is considered as an increasing methodology (more than 85% agreed on that).

2. The Students considered the value of the Match Analyst profile only partially recognised as important by the current sport world (45% agreed on that).

3. Match Analysts specific training should be properly designed (85% agreed on that).

4. Match Analysis procedures play an important role even in Youth Sport (more than 65% agreed no that).

This section confirmed a general consensus of the students   towards the methodology of Match Analysis and the relevant professional profile.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	No answers
	1	2	3	4	5	
1- Match Analysis in Team Sports is a constantly growing methodology.	0%	0%	15%	65%	20%	0%
2 - The value of the Match Analyst's professional profile is widely appreciated throughout the sport world.	0%	22,50%	30%	42,50%	2,50%	2,50%
3 - It is not necessary a specific training to work as Match Analyst.	30%	55%	10%	5%	0%	0%
4 - Match Analysis has no role in the context of Youth Sport.	17,50%	47,50%	25%	5%	5%	0%

Section 2) processed data.

In order to **summarize** what we found in **Section 3)**, we can say that:

1. about 93% of the sample considered crucial working as a Team Unit in modern sport;

2. match analyst's contribution is highly recognised as the one of the fitness or of the technical trainer, or of other major component of the coaching staff;

3. more than 65% of the sample decisively agreed that the Coach on his own cannot perform Match Analysis procedures   effectively, despite his own experiences (65%) and his observation and mnemonic skills (58%);

4. 38% of the sample considered useful at least two people working as Match Analyst within a Coaching Staff. Another 38% considered useful more than two analysts.

5. A Top Technology is required according to 55% of the sample.

6.   83% of the sample does not consider Match Analysis as a current fashion. It will consistently root into the future sport world.

7. This section confirms that most of the students believe that currently sport is about working as a team, (the Coaching Staff), where the interactions among the different specialised members are the key factor to achieve good results.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	No answers
	1	2	3	4	5	
5) In modern Team Sports, the Coaching Staff working as a unit is a crucial issue: the Coach, on his own, will never be able to manage properly all the complexities of training and coaching a team, without the help of highly trained personnel.	0%	2,50%	5%	42,50%	50%	0%
6) The Match Analyst greatly contributes in training and coaching a High Performance Team, together with other professional profiles (the Coach, the Fitness Trainer, the Assistant Coaches, the Medical Doctor, the Psychologist, the Physiotherapist, etc.)	0%	0%	10%	55%	32,50%	2,50%
7-) The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own experience.	15%	40%	40%	5%	0%	0%
8) The Coach on his own may be able to effectively analyse his team and the opposing performance, through his own observational and mnemonic skills.	12,50%	45%	35%	7,50%	0%	0%

9-) The number of people of the Coaching Staff, dedicated to the Match Analysis procedures, should be:
    f)   None   ◊
    g)   1   ◊
    h)   2   ◊
    i)   3   ◊
e) More than 3
	None= 2.5%	1= 25.0%	2= 37.5%	3= 17.5%	More than 3 = 20.0%	

10 –) A Top Level Technology is definitely required in order to provide procedures of Match Analysis suitable to high level Team Sports.	0%	12,50%	30%	47,50%	7,50%	2,50%
11-) Match Analysis is just a moment fashion. It will go probably out of style sooner…	25%	57,50%	12,50%	5%	0%	0%

Section 3) processed data.

In order to **summarize** what we found in **Section 4)**, we can say that:

1. 90% of the sample considered useful organising a specific training course for

    Match Analysts;

2. In two different items (13, 14) we investigated which agency or institution should be responsible for this Training Course. According to the interviewed students it should be organised by:

   - the National Olympic Committee (35%) or the Universities (88%). An ambiguous attitude was found on this issue, maybe for a poor or inappropriate questionnaire design.

3. 73% of the sample would attend a specific course designed with a suitable amount of time appropriate to train qualified personnel (88%);

4. 35% of the sample would attend a Course of 50-100 hours, whereas the 27% would prefer a course with more than 200 hours.

5. The Course should be organised as a specific class at Bachelors' level (35%), at Master Degree's Level (38%) or at Italian Master Level 1° (20%);

6. The students took into account the possibility of a personal economic exposure in order to attend a specific course:

   - 45% of the sample indicated a personal exposure of less than 200 €

   - 27.5% of the sample indicated a personal exposure of 201-500 €

   - 20% of the sample indicated a personal exposure of 501-1.000 €.

This section (item 12-20) confirms that the students have a true interest in qualifying themselves on this matter, through a specific training course, held at University level, both at Bachelor's and/or Master's degree level, with a temporal dimension of about 100 hours. They would pay for that training course a certain amount of money… not a great deal… but enough for a student.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	No answers
	1	2	3	4	5	
12-) I consider useful the organization of a specific Training Course for Match Analysts.	0%	2,50%	7,50%	70%	20%	0%
13-) This Training Course should be organized by Sport Federations and by the National Olympic Committee.	5%	32,50%	27,50%	30%	5%	0%
14-) This Training Course should be organized by the Sport Sciences Universities.	0%	0%	12,50%	47,50%	40%	0%
15-) This Course should be designed with an amount of education time suitable to qualify highly trained personnel.	0%	10%	17,50%	52,50%	20%	0%
16-) This Course should be designed with an amount of education time suitable to qualify highly trained personnel.	0%	2,50%	10%	67,50%	20%	0%
20-) I expect this specific education suitable to let me enter the top sport world as an highly qualified expert.	0%	0%	20%	55%	25%	0%

Section 4) processed data.

11.5.8. Conclusions

This pilot study provided a basic information on the general attitudes of the Students of Sport Sciences toward a new discipline which is gaining more and more relevance day by day.

We can consider this research as a starting point in order to design and propose specific courses for the education and training of the future Match Analysts.

The expectations showed by the interviewed students witness for the relevance of this issue and suggest deeper considerations within the Academic governing bodies, in order to effectively respond to this specific demand of qualification.

Further researches aimed at defining the possible labour market, within the current Italian sports environments, are needed.

11.6. References

Designing a Questionnaire

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Chapter 12

Descriptive and Probabilistic Statistics applied to Match Analysis

12. Descriptive and Probabilistic Statistics applied to Match Analysis: an introduction

Statistics is simply an objective means of interpreting a collection of observations. Various statistical techniques are necessary to describe the **characteristics** of data, test **relationship** between set of data, and the **differences** among sets of data.

Any Match Analysis procedure should be able to provide data that could be processed and interpreted in order to give more knowledge to the possible "clients": coaches, trainers, scholars in Sport Sciences, etc.

The aim of this thesis is not to provide any complete dissertation about statistics, especially the Descriptive Statistics.

We will just underline the relevance of some general concept of the **Descriptive Statistics** more involved in the Match Analysis procedures, then focusing prevalently on the **Probabilistic** approach, that seems to be really promising on the line of research devoted to the Match Analysis.

12.1.   Descriptive Statistics mostly applied in Match Analisys

Statistics are used to describe data, to determine relationships among variables, and to test for differences among groups. The type of statistics used does not determine whether findings can be generalised; rather it is **sampling** that permits (or limits) inference. Whenever possible, **random sampling** is the method of choice, but in behavioural research, as in Match Analysis, the more important question may be whether the sample is "good enough". In some types of research, such as in **surveys**, stratified random sampling is desirable for the study to represent certain segment of a population. **But sometimes, especially while referring to top level sports, the sample is usually a little one, thus not permitting a generalisation to the whole population or universe.**

It is important to remember that statistics can do two things: establish significance and assess meaningfulness. Significance means that a relationship or difference is reliable – that you could expect it to happen again if the study were repeated. Meaningfulness refers to the importance of the results.

12.1.1.　　Measures of Central Tendency and Variability

Some of the more easily understood statistical and mathematical calculations are those that find **central tendency** and **variability** of scores. When you have a group of scores, one number may be used to represent the group. That number is generally the **mean**, **median** or **mode.** These terms are ways of expressing **central tendency.** Within the group of scores, each individual score differs to some degree from the central tendency score. The degree of difference is the score's **variability**. Two terms that describe the variability of the scores are **standard deviations** and **variance.**

The statistic for central tendency score, which is probably the best known, is the **mean** (**M**) or **average**:

$M = \Sigma X/N$ 　　　(12.1)

Here we provide a brief glossary of the terms most used while referring to central tendency (see table 1).

Term	Meaning
Central Tendency	A single score that best represents all of the scores
Variability	The degree of difference between each individual score and the central tendency score
Standard Deviation	An estimate of the variability of thr scores of a group around the mean
Variance	The square of the standard deviation
Median	A statistical measure of central tendency that is the middle score in a group
Mode	A statistical measure of central tendency that is the most frequently occurring score of the group
Standard Error	The variability of the sampling distribution

Table 1 – A glossary of the Central Tendency

Confidence Intervals

Confidence intervals represent an effective technique used by researchers to help interpret a variety of statistics such as means, medians, and correlations. They are also used in hypothesis testing. A confidence interval provides an expected and lower limit for a statistic at a specified probability level, usually either 95% or 99% (P-values). The size, or length, of a confidence interval is affected by the size of the sample, the homogeneity of values within the sample, and the level of confidence selected by the researcher. Confidence intervals are based on the fact that any statistic possesses sampling error. This error relates to how well the statistic represents the target population.

12.1.2.   Relationships among Variables

Correlation is a statistical technique used to determine the relationship between two or more variables. The coefficient of correlation is a quantitative value of the relationship between two or more variables that can range from 0.00 to 1.00 in either a positive or negative direction. Positive correlation is a relationship between two variables in which a small value for one variable is associated with a small value for another variable, and a large value for one variable is associated with a large value for the other. On the contrary a negative correlation is a relationship between two variables in which a small value for the first variable is associated with a large value for the second variable, and a large value for the first variable is associated with a small value for the second variable. The Pearson product moment coefficient of correlation *is the most commonly used method of computing correlation between two variables; it is also called interclass correlation, simple correlation or Pearson r.*

The simplest type of correlation is the **Pearson r correlation**, which describes the relationship between two variables. We may also perform **linear regression**, which can be used to predict one variable from another. Correlation is interpreted for **significance** (reliability) and for **meaningfulness** (r2), which indicates the portion of the total variance in one measure that can be explained or accounted for by the other measure.

Partial correlation is a procedure in which a correlation between two variables is obtained while the influence of one or more other variables is held constant.

Semipartial correlation removes the influence of a third variable on only one of the two variables being correlated. Partial correlation (or Semipartial correlation) is used in **multiple correlation** and in developing **multiple-regression formulas**.

In **multiple regression** two or more **predictor** (independent) variables are used to predict the **criterion variable**. The most efficient weighted linear composite of predictor variables is determined through such techniques as **forward selection, backward selection, stepwise selection, and maximum R squared**.

Finally, three multivariate correlation procedures may be applied while processing data obtained through the Match Analysis procedures: canonical correlation, factor analysis, and structural equation modelling.

12.1.3.   Differences Among Groups

Statistical techniques are used for describing and finding relationship among variables. They are also used to detect **differences among groups**. The latter techniques are most frequently used for data analysis in experimental and quasi-experimental research. They enable us to evaluate the effects of an independent (cause or treatment) or categorical (sex, age, race, etc.) variable on a dependent variable (effect, outcome). One must keep in mind that these techniques are not used in isolation to establish cause and effect but only to evaluate the influence of the independent variable. Cause and effect are not established by statistics but by theory, logic, and the total nature of the experimental situation.

The purpose of the statistical techniques is to evaluate the null hypothesis at a specific level ot probability (e.g., p<.05). The statistical test is always of the null hypothesis. All that statistics can do is reject or fail to reject the null hypothesis. Statistics cannot accept the research hypothesis. Only logical reasoning, good experimental design, and appropriate theorizing can do so. Statistics can determine only whether the groups are different, not why they are different.

One of the most used statistical test in analysing differences among groups is the *t Tests*.   There are three types of *t Test: tTest between a sample and a population mean (1), t Test for independent groups (2) and t Test for dependent groups (3).* The *t Tests* is a test of the null-hypothesis, which states that there is no difference between the sample mean (M) and the population mean (1) or whether two samples means differ reliably from each other (2). The dependent t

Test (3) is a test of the significance of differences between means of two sets of scores that are related, such as when the same participants are measured on two occasions.

Other statistical techniques often applied to this line of research are:

1. Analysis of Variance (Anova)
2. Analysis of Covariance (Ancova)
3. Discriminant Analysis (Forward, Backward, Stepwise selection)
4. Multivariate Analysis of Variance (Manova)
5. Multivariate Analysis of Covariance (Mancova).

12.1.4. Non Parametric Techniques

In the preceding paragraphs, various **parametric** statistics were described. The parametric statistics make assumptions about the normality and homogeneity of variance of the distribution. Another category of statistics is called **nonparametric statistics**. This category is also referred to as distrihution-free statistics because no assumptions are made about the distribution of scores. Non parametric statistics are versatile in that they can deal with ranked scores and categories. This can be a definite advantage when the investigator is dealing with variables that do not lend themselves to precise, interval-type or ratio-type data (which are more likely to meet parametric assumptions), such as categories of responses on questionnaires and various affective behaviour rating instruments.

Data from quantitative research are frequently numerical counts of events that can be effectively analysed with nonparametric statistics. The main drawback to nonparametric statistics that has often heen voiced is that they are less powerful than parametric statistics, but it should be pointed out that there is no agreement regarding the supposed power advantage of parametric tests.

Chi Square: Testing the Observed Versus the Expected

Data are often sorted into categories, such as sex, age, grade level, treatment groups, or some other nominal (categorical) measure. A researcher is sometimes interested in evaluating whether the number of cases in each category is different from what would he expected on the basis of chance, some known source of information (such as census data), or some other rational hypothesis about the

clistrihution of cases in the population. **Chi square** provides a statistical test of the significance of the discrepancy between the observed and the expected results.

The formula for **chi square** is:

$$X^2 = \Sigma[(O - E)^2 / E] \qquad\qquad (12.2)$$

where O = the observed frequency and E = the expected frequency. Thus, the expected frequency in each category-often labelled "cells" as in a table divided into four equal boxes-is subtracted from the observed (or obtained) frequency. This difference is then squared (which means all differences will be positive), and these values are divided by the expected frequency for their respective categories and then summed.

12.2. Probabilistic Statistics mostly applied in Match Analysis

Another concept that deals with statistical techniques is probability, which asks what are the odds that certain things will happen.

A concept of probability related to statistics is called **equally likely events**, namely a concept of probability in which the chances of one event occurring are the same as the chances of another event occurring.

Another pertinent approach to probability involves **relative frequency,** that is a concept of probability concerning the comparative likelihood of two or more events occurring.

12.2.1.   Introduction to Stochastic Processes

A stochastic process $\{ X(t), t \in T \}$ is a family of random variables. That is, for each t contained in the index set $T, x(t)$ is a random variable. The variable t is often interpret+ed as time, and hence $X(t)$ represents the *state* of the process time $t.$ For instance, $X(t)$ may represent the amount of inventory in a retail store at time t or the number of people in in a bank at time t or the position of a particle at time $t,$ etc.

The set T is called the *index set* of the stochastic process. If T is a countable set, then the stochastic process is said to be a *discrete time* process. If T is an open or closed interval of the real time, then we say that the stochastic process is a *continuous time* process.

The set of possible values which the random variables $X(t), t \in T$ may assume is called the *state space* of the process.

A continuous time stochastic process $\{ X(t), t \in T \}$ is said to have *independent increments* if for all choices of $t_0 < t_1 < t_2 < \ldots < t_n,$ the n random variables

$X(t_1) - X(t_0), X(t_2) - X(t_1), \ldots, X(t_n) - X(t_{n-1})$

are independent. The process is said to have station increments if in addition

$X(t_2 + s) - X(t_1 + s)$ has the same distribution as $X(t_2) - X(t_1)$ for all $t_1, t_2 \in T$ and $s > 0.$

12.2.2. The Poisson Process

A stochastic process **{ N (t), t ≥ 0 }** is said to be a *counting process if **N(t)*** represents the total number of events which have occurred up to time **t**. A particularly important counting process is the Poisson process.

Definition

The counting process **{ N (t), t ≥ 0 }** is said to be a **Poisson Process** if :

i.   **N(0) = 0**

ii.   **{ N (t), t ≥ 0 } has independent increments;**

iii. **the number of events in any interval of length t has a Poisson distribution with mean λt. That is, for all s, t ≥ 0,**

$$P\{N(t+s) - N(s) = n\} = e^{-\lambda t}\frac{(\lambda t)^n}{n!}, \ n \geq 0$$

From (iii), it follows that

$$E[N(t)] = \lambda t$$

And λ is called the rate of the process.

12.2.3. Markov Chains

A stochastic process $\{X_n, \ n = 0,1,2,\ldots\}$, with a finite or countable state space, is said to be a **Markov chain** if for all states $i_0, \ i_1, \ \ldots, \ i_{n-1}, \ i, \ j,$ and all $n \geq 0.$

$$P\{X_{n+1} = j \mid X_0 = i_0, \ X_1 = i_1, \ldots, X_{n-1} = i_{n-1}, X_n = i\}$$

$$= P \{X_{n+1} = j \mid X_n = i\}.$$

If $P \{X_{n+1} = j \mid X_n = i\}$ is independent of n, then the Markov chain is said to possess stationary transition probabilities. We shall only consider Markov chains with this property, and we shall let

$$P_{ij} = P \{X_{n+1} = j \mid X_n = I\}$$

12.2.4. The Wiener Process and the Brownian Motion

Historical Background

One of the most useful stochastic processes in applied probability theory is the Wiener process. The Wiener process originated in physics, as a description of Brownian motion.

Brownian motion is a sophisticated random number generator, based on a process in plants discovered by the Scottish botanist Robert Brown (1773-1858) in 1827.

Figure 1 – Robert Brown

He found that small particles suspended in a fluid were in continuous movement and thus, described it as **Brownian motion**. His discovery did not receive any attention for a long time, until 1890 when Guoy's researches (that Brownian motion constituted a clear demonstration of the existence of molecules in continuous motion) brought it to the attention of the Physics world.

In 1905 Albert Einstein succeeded in stating the mathematical laws governing the movements of particles on the basis of the principles of the kinetic-molecular theory of heat. According to this theory, bodies of microscopically visible size suspended in a liquid will perform irregular thermal movements called Brownian molecular motion.

However, the first concise definition of this stochastic process underlying Brownian Motion was given by Wiener[1] in a series of papers originating in 1918. The definition of this process, known as the Wiener process, or simply the Brownian motion process, is as follows.
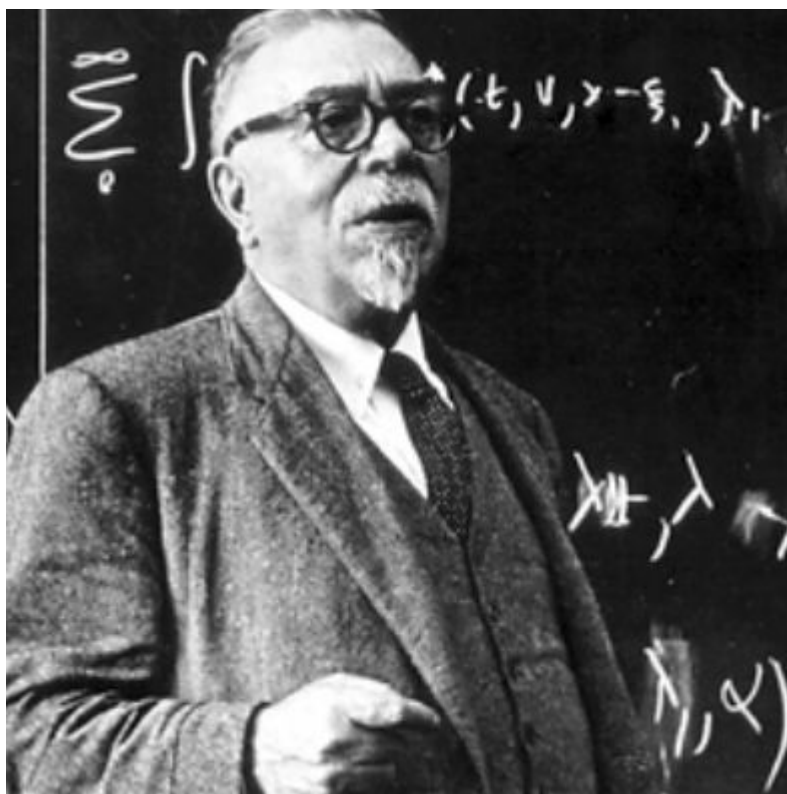
Figure 2 – Norbert Wiener

Stochastic process [X (t), t $\geq$ 0] is said to be a Wiener process with drift coefficient μ if:

X (0) = 0

{ X (t), t $\geq$ 0 } has stationary independent increments;

for every t > 0, X (t) is normally distributed with mean μ t.

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[1] **Norbert Wiener** (1894-1964) - American theoretical and applied mathematician.Wiener was a pioneer in the study of **stochastic** and noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems.Wiener also founded **cybernetics**, a field that formalizes the notion of feedback and has implications for engineering, systems control, computer science, biology, philosophy, and the organization of society.

Brownian motion was then more generally accepted because it could now be treated as a practical mathematical model. As a result, many scientific theories and applications related to it have been developed and they subsequently play major roles in the world of Physics.

12.2.5.　　　The Elementary Theory of Brownian Motion

The **'Elementary theory of Brownian motion'** is one of the major investigations by Einstein on the Brownian movement theory, carried out in 1908. In this paper, the term "Brownian motion" is referred to as the **irregular** and **unceasing** movement of solid microscopic particles when suspended in a fluid medium.

In an undissociated dilute solution there is a process of diffusion2, which is caused by the Brownian motion of the suspended thermal molecules. On the other hand, another process proceeding in the opposite direction of that of the diffusion one also occurs. Osmotic pressure forces bring about this movement of suspended substances[3].

The first step in the investigation of Brownian motion is to show how the process of diffusion depends on the distribution of osmotic pressure in the solution. The relationship btween the diffusion and the mobility of the dissolved substance in the solvent is also to be found.

In his investigation, Einstein explained the above relationships by using a cylindrical vessel containing a dilute solution of two different concentrations. A movable piston is used as a semi-permeable partition to divide the solution. This would allow both the diffusion and the osmosis processes to take place. Osmotic differences exist as a result of the variation in concentrations. This phenomenon creates an osmotic pressure force that brings about the equalization of the concentrations in diffusion. Therefore, osmotic pressure can be looked upon as the driving force in diffusion

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[2] **Diffusion** is a process of interpenetration between two substances, without chemical combination, by the natural movement of the particles.
[3] **Osmosis** is the passage of a solvent from a less concentrated into a more concentrated solution through a semi-permeable membrane, i.e permeable to the solvent but not to the solution.

cases. A mathematical evaluation of this phenomenon, based on the kinetic molecular theory of heat, produced an expression for the diffusion coefficient. This coefficient was found to be independent of the nature of the solution except for the viscosity of the solvent and for the size of the solute molecules.

The expression of a diffusion process, as discussed above, is eventually related to the irregular motion of the solute particles, with the aid of the same vessel model. The molecular theory of heat also affords a second point of view that the individual molecules of a liquid will alter their positions in a random manner. This wandering about of the particles concerned will result in a uniform distribution of concentration of solute from the non-uniform one, which is a diffusion process. Detailed mathematical procedures presented by Einstein show that the average magnitude of the random motions of solute particles can be calculated from the diffusion coefficient. Alternatively, with the results derived from the previous step, this measure can also be obtained from the viscosity of the solvent, the size of the solute as well as the absolute temperature. Thus, the relationship between the path described by solute particles in a solution and the process of diffusion had been established.

According to the molecular kinetic conception, there exists no essential difference between a solute molecule and a suspended particle. Hence, the elementary theory of Brownian motion can be applied to any kind of small-suspended spherical particles.

12.2.6. Fractals

Before we go into the detailed applications of Brownian motion, the concept of 'fractal' has to be introduced, as it plays a major part in many important applications of our subject.

IBM researcher Benoit B.Mandelbrot introduced the concept 'fractal' nearly two decades ago. Expressed in its simplest form, 'fractals' refer to images in the real world, which tend to consist of many complex patterns that recur at various sizes.

Mandelbrot proposed the idea of a fractal (short for "fractional dimension") as a way to cope with problems of scale in the real world. He defined a fractal to be any curve or surface that is independent of scale. This property, referred to as self-similarity, means that any portion of the curve, if blown up in scale, would appear identical to

the whole curve. Thus the transition from one scale to another can be represented as iterations of a scaling process (e.g. Fig. 3).
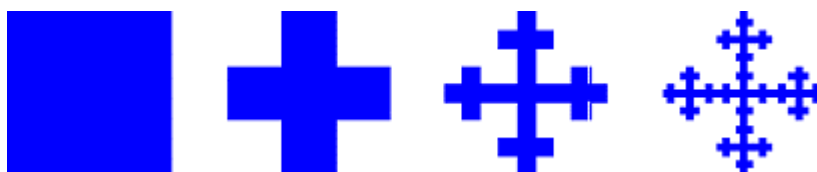
Figure 3   Forming a cross by iteration of a simple procedure.

An important difference between fractal curves and the idealized curves that are normally applied to natural processes is that fractals are nowhere differentiable. That is, although they are continuous (smooth), they are kinked everywhere. Fractals can be characterized by the way in which representation of their structure changes with changing scale.

Fractal dimension

The notion of "fractional dimension" provides a way to measure how rough fractal curves are. We normally consider lines to have a dimension of 1, surfaces a dimension of 2 and solids a dimension of 3. However, a rough curve wanders around on a surface; in the extreme it may be so rough that it effectively fills the surface on which it lies. Very convoluted surfaces, such as a tree's foliage or the internal surfaces of lungs, may effectively be three-dimensional structures. We can therefore think of roughness as an increase in dimension: a rough curve has a dimension between 1 and 2, and a rough surface has a dimension somewhere between 2 and 3. The dimension of a fractal curve is a number that characterizes the way in which the measured length between given points increases as scale decreases. Whilst the topological dimension of a line is always 1 and that of a surface always 2, the fractal dimension may be any real number between 1 and 2.

Fractals and Brownian motion

Fractals are said to be self-similar. The idea of self-similarity means that if we minimize or enlarge a fractal pattern, its appearance should remain unchanged. On the other hand, fractal patterns usually arise when simple patterns are transformed repetitively on smaller and smaller scales (e.g. Fig. 3).

 An important class of processes that produce fractal patterns are random iteration algorithms (like Brownian motion), which produce images of fractal objects. The procedure is similar to using a pen to mark dots at random on a sheet of paper. However, instead of being completely random, the movement of the pen from one position to the next is selected, at random, from a set of rules, each having a fixed probability of being chosen.

Brownian Motion is an example of a process that has a fractal dimension of 2. One of its occurrences is in microscopic particles and is the result of random pushing by water molecules (if water is the medium). The path of such a particle is a "random walk" in which both direction and distance are uniformly distributed random variables. So in moving from a given location in space to any other, the path taken by the particle is almost certain to fill the whole space before it reaches the exact point that is the 'destination' (hence the fractal dimension of 2).

One important result of combining the theory of fractals and Brownian motion is the 'fractional Brownian motion model'. This model regards naturally occurring rough surfaces (like mountains, clouds and trees) as the end result of random walks, and utilizes a random iteration algorithm to produce fractal patterns.

Another aspect of Brownian motion is its effect on the formation of aggregates such as crystals. Figure 4 shows structures formed under different assumptions about the relative rate of horizontal movement (h) and the probability (p) of a settling particle sticking to fixed particles as it brushes past. In the figure the following values are shown: (a) h=1, p=0; (b) h=1, p=1; (c) h=10, p=0; (d) h=10, p=1. "Sticky" particles (p=1 in the figure) tend to form structures resembling (say) trees or mosses. Such properties are exploited in animation to generate pictures of artificial plants and landscapes.
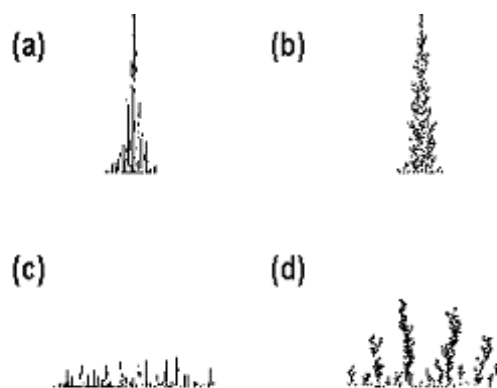
Figure 4 Structures arising from Brownian motion of falling particles.

Some of the applications of Brownian motion involving fractal analysis are given below:

12.2.7.   Applications of Brownian Motion in imaging processing

One of the more successful engineering applications of the fractal geometry has been the utilization of fractal image models in image processing. In this case, particularly interesting are the medical applications.

These applications include tissue characterization studies and textural image segmentation. Results from human vision experiments show that lines of high fractal dimensions are highly incapable of evoking identification with nameable objects. This is because of the high degree of pattern complexity involved. In other words, only regular lines are recognized in human vision as object edges. Following Mandelbrot's fractal theory, fractal dimension could be obtained in medical images by the concept of Brownian motion.

Medical images, like other natural phenomena, have a degree of randomness associated with both the natural random nature of the underlying structure and the random noise superimposed on the image. The fractional Brownian motion model regards natural occurring surfaces as the result of random walks. Thus, the Brownian motion model can treat an intensity of medical image fractionally.

Chen and Fox managed to find two applications of fractal analysis in medical imaging, which are given as follows:

Classification

Classification refers to the identification of normal and abnormal ultrasonic liver images. Conventional statistical techniques have always been attempted in the past to distinguish among these images. For example, Pentland[4] classified the textures of an image by computing the Fourier transform of the image and determining its power spectrum. He then applied a linear regression technique on the log of the power spectrum to estimate the fractal dimension. However, the fractal concept suggested by Chen and Fox have a more natural theoretical connection to the underlying processes of image formation. Abandoning the conventional methods, a normalized fractional Brownian motion feature vector is defined to represent the statistical features of the image surface from the Brownian motion estimation concept. The objective of this concept is to obtain the average absolute intensity difference of pixel pairs(e.g 7*7 pixel pair) at different scales. Different ultrasonic images were compared based on the differences among the feature vectors. This is because real surfaces in medical images are not perfect fractal surfaces and their statistical features cannot be represented by a single value for the fractal dimension.

Edge enhancement

This basic approach was suggested from Pentland [4] for image segmentation and edge detection. Instead of using the Fourier power spectrum analysis, a transformed image of the liver was obtained by calculating the fractal dimension of each pixel over the whole medical image. To get the fractal dimension value of each pixel, the calculation for the fractal dimension of a 7*7 pixel block centred on this pixel was recommended. The fractal dimension distribution appears to hold promise as edge enhancement that does not increase noise in the way that convolution (in Fourier transform) algorithm do. The transformation can thus enhance the detection of edges over the original image.

These two techniques, although their computations are rather time consuming, could provide a potential noninvasive alternative to 'needle biopsy', which was then the only definitive test for distinguishing among liver abnormalities such as fatty infiltration, hepatitis and cirrhosis. The traditional method of 'needle biopsy' is often contraindicated in patients with liver disease due to coagulation abnormalities, and hence not as effective in identification of the malignant cells.

The work of Basu S. and Chan K.S. [5] also delivered some preliminary results of a study aimed to assess the actual effectiveness of fractal theory in the area of medical image analysis for texture description. Their specific goal was to utilize fractal dimension to discriminate between normal and cancerous human cells. In particular, they considered four types of cells, namely, breast, bronchial, ovarian and uterine cells. The 'fractional Brownian motion model' was employed to compute the fractal dimension of the different kinds of cells studied. In their experiments with real images (of cells), they concluded that the range of scales (detailed mathematical descriptions not discussed here) over which the cancerous cells exhibit fractal property compared to that of normal, healthy cells differed quite significantly, and hence that property can be used as a discriminatory feature to identify cancerous cells. They proposed that this method can be used for the relatively quick and accurate identification of other forms of malignant cells, and this could prove invaluable to researchers and doctors in the profession.

12.2.8.   Image processing and fractals in sports environments

The particular power of fractals algorithms in processing images has got an important role also in sport environments.

A major issue among sports insiders is gathering information from images and videos. Very often the quality of images (or videos) is not at the level required by a scientific investigation, both in terms of definition and sharpness. Particularly important seems to be this issue while we are considering extracting information from pictures representing two athletes engaged in a close fight situation, where even the smallest detail could represent an important aspect of the whole performance, under different points of view (coaching, training, conditioning, umpiring, sport commentaries, investigation in injuries causes, (see pictures below) etc.).

Currently many "scaling imaging tools", based on fractals algorithms, are available and they can efficiently support the work of Match Analysts, in providing extraordinary qualitative enlargement (or resizing) of the available pictures (up to thousands times), thus allowing more precise qualitative evaluation, starting even from "amateur pictures".

For more information see:

http://www.samys.com/product_detail.php?item=10921&showAccessories=1#detail

A)
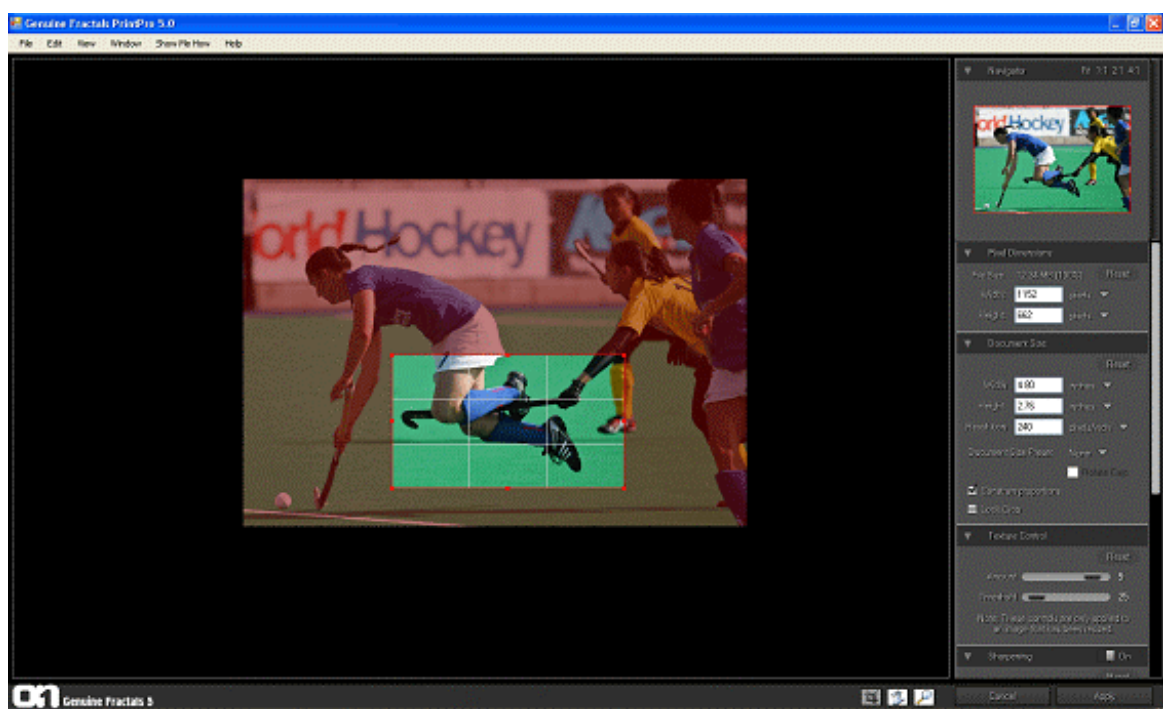
B)
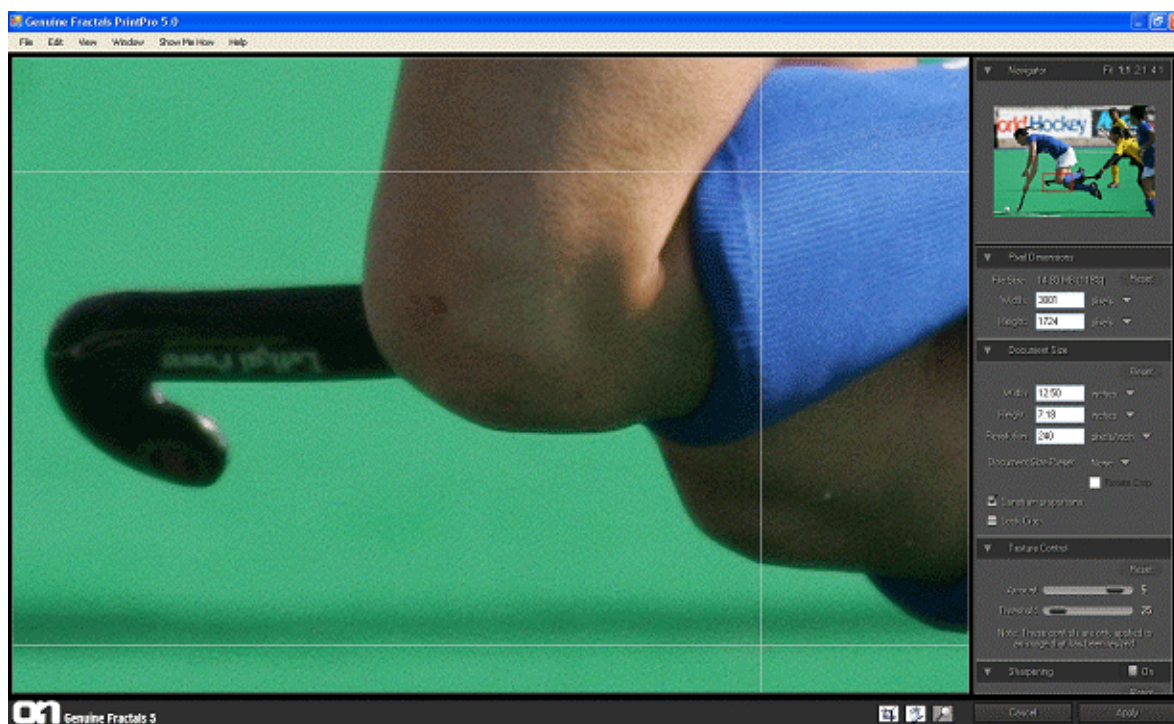
C)

Figure 5 – A, B, C: Using fractals algorithms in order to magnify small details in sport pictures. ("Genuine Fractals 5 ®")

12.2.9.   Applications of Brownian motion

Market Analysis and Sport

As previously reported, many features from the economics world are extremely related to the sports environment. There is always a factor of uncertainty in any economic situation, including sport, and in order to make the right investment or tactic decisions, or to choose the right business or game strategy, we require some form of workable hypothesis (that takes into account uncertainty and randomness) to base our decisions upon.

Background Information

Around 1900, L. Bachelier [8] first proposed that financial markets follow a "random walk" which can be modelled by standard probability calculus. In the simplest terms, a "random walk" is essentially a Brownian motion where the previous change in the value of a variable is unrelated to future or past changes.

Brownian motion has desirable mathematical characteristics, where statistics can be estimated with great precision, and probabilities can be calculated, and hence scientists and analysts often turn to such an independent process when faced with the analysis of a multidimensional process of unknown origin (ie. the stock market or… a match). The Brownian motion theory and Random Walk model are widely applied to the modelling of markets, and the insight that speculation can be modelled by probabilities extends from Bachelier and continues to this day.

The possibility to extend this line of research to the sport environments seems to promising. Further researches on this issue are needed at date.

Brownian Motion in the Stock Market

In the middle of this century, work done by M.F.M Osborne showed that the logarithms of common-stock prices, and the value of money, can be regarded as an ensemble of decisions in statistical equilibrium, and that this ensemble of logarithms of prices, each varying with time, has a close analogy with the ensemble of coordinates of a large number of molecules. Using a probability distribution function and the prices of the same random stock choice at random times, he was able to derive a steady state distribution function, which is precisely the probability distribution for a particle in Brownian motion. A similar distribution holds for the value of money, measured approximately by stock market indices. Sufficient, but not necessary conditions to derive this distribution quantitatively are given by the conditions of trading, and the Weber-Fechner law[4].

A consequence of the distribution function is that the expectation values for price itself increases, with increasing time intervals 't', at a rate of 3 to 5 percent per year, with increasing fluctuation, or dispersion, of Price. This secular increase has nothing to do with long-term inflation, or the growth of assets in a capitalistic economy, since the expected reciprocal of price, or number of shares purchasable in the future, per dollar, increases with time in an identical fashion. Thus, it was shown in his paper that prices in the market do vary in a similar fashion to molecules in Brownian motion.

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[4] The Weber-Fechner law states that equal ratios of physical stimulus, for example, sound frequency in vibrations/sec, correspond to equal intervals of subjective sensation, such as pitch. The value of a subjective sensation, like absolute position in physical space, is not measurable, but changes or differences in sensation are, since by experiment they can be equated, and reproduced, thus fulfilling the criteria of measurability.

A more specific example of how Brownian motion is applied to determine investment strategies is seen in S.J. Grossman and J.L. Vila's study. Their aim was to solve for the optimal dynamic trading strategy of an investor who faces a leverage constraint (ie. a limitation on his ability to borrow for the purpose of investing in a risky asset). A second constraint is also taken into account, and that is the requirement that the investor's wealth be non-negative at all times. The investor is assumed to be relatively risk averse, and the value of the risky asset he wants to invest in follows a Geometric Brownian motion, where the price fluctuates per unit time variance (ie. according to the square root of time). It is the use of the Geometric Brownian motion of the risky asset that allows a conclusive and quantitative analysis to be reached in their paper. They presented a number of applications of their results. The most direct application is for an investor who must put up margin (a minimum amount) for his investment in stocks or futures. Using their method compared the 'Constant Proportion Portfolio Insurance (CPPI) strategy, which was the standard evaluation technique of the period, they showed, using numerical analysis, that the CPPI strategy tended to be quite myopic, and that their strategy provided explicit solutions to optimal portfolio problems containing leverage and minimum portfolio return constraints. Hence, in their analysis where the value of a risky asset was modelled using a form of Brownian motion, a much safer and more accurate course of action for investors was proposed.

Further researches, following these lines, applied in sport environments, are needed, in order to define the optimal decision making process to adopt while considering the strategy and some tactic of the sport games.
Other examples of this topic are reported below.

 Brownian Motion in Decision Making
An example is cited which shows how Brownian motion is used as the starting point for an investigation into the **optimal switching times in an economic activity under uncertainty**, by K.A. Brekke and B. Oksendal. Their research considers the problem of finding the optimal sequence of opening (starting) and closing (stopping) times of a multi-activity production process, given the costs of opening, running, and closing the activities and assuming that the state of the economic system is a stochastic process. For example, there are industries where part of the production process is temporarily shut down when electricity prices are too high; at high prices

all workers are relocated to other tasks and when the prices fall below a certain limit, production is restarted. **Such situations where decisions have to be made as to when to shut down, restart, then shut down again is called** *"optimal switching problems'.*

There had been previous investigations into optimal switching problems, but none of them provided any rigorous mathematical proof that an optimal starting and stopping strategy exists. The work done by Brekke and Oksendal modelled the price of a resource as one following a geometric Brownian motion, and they subsequently proved explicitly that an optimal starting and stopping strategy does exist for the particular resource extraction.

As an example of their research, suppose the costs of opening, running and closing down a field for resource extraction are known, and the price of the resource under consideration is varying according to a geometric Brownian motion. When would be the optimal time to open the field and to close it again? It would be reasonable to say that if the field is open, it may be a good strategy to continue extraction for a while even if the price has gone below running costs, because there may be a chance that prices could go up again. Furthermore, opening and closing the field is a costly process. On the other hand, even with such an optimistic point of view there is clearly a limit as to how low the prices can go before closing is the optimal strategy. **Thus, using the mathematics of Brownian motion, they were able to prove explicitly that an optimal solution exists for the problem, and also for other similar situations.**

The Brownian motion model was also made use of by L. Romanow to develop a model for a decision making process in which action is taken when a **threshold criterion level is reached.** The model is developed with reference to career mobility: it provides an explanation of an important feature of promotion processes in internal labour markets.

In the decision process examined, performance is observed and rated over time and an observed score is compared with a predetermined standard. Action is taken when a threshold criterion is reached. For example, an employer promotes an employee when his observed average performance level is above 8 on a scale of 1

to 10. In the investigation, promotion decisions are determined by assessment of the quality of the match between the individual and the job, random factors involved in assessing the match, and the employer's personnel policy based on the costs of making errors in judgement. When applied to data, the estimated parameter values of the model indicate the relative importance of each of these factors in determining the time to promotion.

The model developed uses a Brownian mathematical formulation for a decision process used for sampling performance. One advantage of the modelling framework developed is that the resulting probability distribution functions can be expressed analytically rather than by simulation. The threshold process is formulated in continuous state space and continuous time, which makes it possible to model a cumulative record of performance as a Brownian motion process.

With respect to careers, the model reflects some ordinary notions about why people change jobs. The explanation offered supposes that career decisions are based on an evaluative record of the quality of the job match. Three factors are key in determining job mobility decisions: the assessment of the quality of the job match; the noise, or random factors, that influence evaluation; and the decision maker's scepticism about his estimate of the quality (of the job).

The model also assumes continuous observation of behaviour (of employees) and that the only route for leaving a job is by promotion. This suggests that the important mechanisms in the process are the basic evaluation procedure - rating which includes a random component (Brownian motion theory), and the decision rule - promote when an estimated average reaches a criterion level. The model was able to provide **substantive qualitative results** and hence is of good use to the 'real' world in decision-making policies.

12.2.10.   Conclusion

The Brownian motion theory has come a long way since its humble beginnings in the nineteenth century, and there now exists a large number of applications that have evolved from it and countless others that revolve around it. This theory covers such a vast number of interesting aspects of life without our being aware of its role. The examples we have cited are a mere speck of the research that has been done to date. With the random and often unpredictable nature of events that take place in this world of ours, it is no wonder that researchers have yet to find the perfect solutions to their unending problems. Hence, Brownian motion will remain a strong research area in the coming days, and it is certainly not going to become obsolete in the scientific world, where new technologies are constantly being developed to replace the old ones.

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Chapter 13

A Case Study: Field Hockey, Information and Training: the winning duet.

13.1.   The sport and the need of specific information

Match Analysis is a major issue among coaches, team managers and sport scientists. Information and information processes *[Hughes and Franks, 2004]* are the key factors while referring to this aspect of sport methodology.

Field Hockey *[Whitaker, 1992; Mignardi and Ruscello, 1993,2006; Bonsignore and Ruscello, 2006]* is a world-wide known outdoor Olympic team sport and one of the most popular considering the over 120 existing national federations.

Most of the information available in Field Hockey is referred to the bio-energetic aspects *[Murphy et al., 2003; Spencer et al., 2005]* of the game and some of the biomechanics of the complex technique of this sport *[Stuelcken, 2003; Camomilla et al., 2008;]*.

Few researches are available referring to the tactical aspects of the game although this issue is felt extremely important by the vast majority of the coaches, at all levels *[Kormelink and Seeverens, 1999; Hughes and Franks, 2004; Sacripanti, 2007, Ciuffarella and Ruscello, 2008; Ruscello 2008]*.

Indeed a crucial aspect of Match Analysis is the kind of support it could provide to coaches in real-time, namely during a game or a tournament, while the information felt as the most important by coaches and players is the one related to the tactical and strategical aspects of the game/tournament going on. In this case we are referring to a particular feature of Hockey, Penalty Corners, which are extremely important for the "whole economy" of this sport, since a vast percentage of goals are scored during this particular situation *[Whitaker, 1992; Laird and Sutherland, 2003]*.

Our aims were to describe, test and define a methodology of Video-Computerized Match Analysis System *[Kormelink and Seeverens, 1999; Carling et al.; 2005]* applied to Field Hockey, able to support consistently the work of coaches in assessing qualitatively the team performance and, by the means of Data Mining, *[Han and Kamber, 2001; Solieman, 2006]* describe the relevant patterns which could characterize a specific team in its tactical features.

In this study, the inner tactical structures of the penalty corners performed by the Teams participating in the Women Hockey Olympic Qualifier held in Victoria (Canada) in April-May 2008, were qualitatively analyzed in order to detect the

crucial features to be considered in future sessions of training, in order to maximize the possible outcomes of this crucial structure of the game.

The research was carried out by, Ruscello Bruno[1]-[2],.Sacripanti Attilio[2]-[3] and Gianluca Iaccarino[1].

The poster of this research was presented at the "Team Sport Conference", organised by the University of Verona, at Verona-Ghirada on 7-8th June 2008. The abstract published by the *Coaching and Sport Science Journal[4].*

In this chapter we will introduce this methodology of match analysis applied to "Attacking and Defending Penalty Corners".

13.2.   Using commercial software

In order to acquire, process and presenting the data related to the tactical aspect of the game, at international level, the author used a commercial software of video-match analysis, the *NAC Sport PRO 32®* (fig. 1)

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[1] Italian Hockey Federation
[2] Sport Sciences Dep., Faculty of Medicine, Tor Vergata University, Roma, ITALY
[3] ENEA - Italian National Agency for New Technologies, Energy and the Environment
[4] " Match Analysis in Field Hockey. Information and Training. The winning duet"; di Ruscello B., Iaccarino G., Sacripanti A.; Coaching and Sport Science Journal; Volume 3 – Numero 2, Maggio-Agosto 2008; pp. 12-13
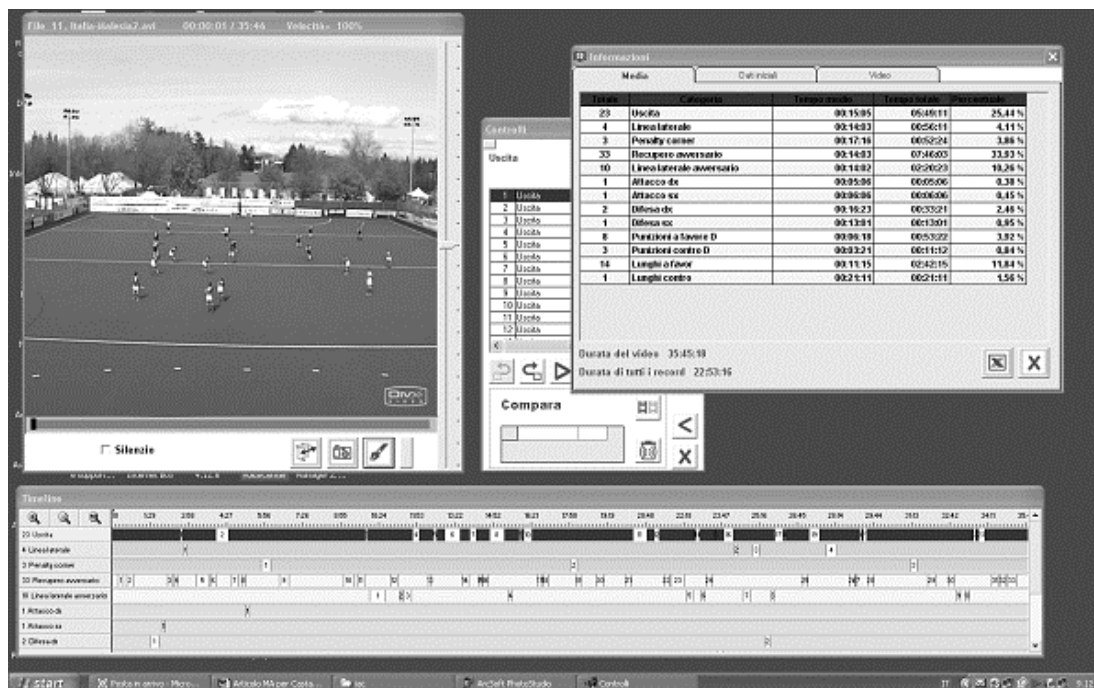
Fig. 1 – Analysing the data of a Match. NAC Sport 32 ®

This software allows the analysts to get rapidly information about the qualitative features of the games, processing video files (.avi or .mpeg2 format) or directly linking a laptop to a video camera in order to acquire and analyze in real time the ongoing matches.

Some specific features of the NAC software are reported below:

- **File viewing and recording**

View and record events from all saved video files.

- **Real time viewing and recording**

View and record events in real time by capturing images as they occur.

- **Voice recognition recording**

Event recording and video player control via voice.

- **Real time video digitization and compression**

Image digitization and compression as they are recorded.

- **Selection of digitization quality (DV or compressed)**

Two video digitization options: DV, first class quality but large files and compressed, providing optimum operating

- **Configuration of multiple codecs for video recording**

Manual or pre-set selection of the configuration of the parameters required for video recording both in compressed and DV quality.

- **Configuration of multiple recording devices**

Compatibility with different recording devices (internal, external, webcam, DV camera, etc.) and configuration of different parameters for each (frames per second, format, video input, resolution, etc.).

- **Editing list of events from one video**

Prompt and simple creation of an unlimited number of previously saved collections of recordings, referenced to only one video.

- **Presentation of lists of events**

Direct access to all lists of events for management and viewing on a floating window video player.

- **Comparison of events and videos**

Comparison of two events from the same or different videos frame by frame by means of an independent or simultaneous control.

- **Superimposition of events and videos**

Superimpose two similar events or videos for analytical purpose, selecting to play them frame by frame by configuring the independent contrast of each one.

- **Event management through the timeline**

Fast and simple access to all recorded information through a time-action ratio window, for both viewing and editing purposes.

- **Video production in different formats**

Possibility of generating a video with selected recordings in three formats: AVI (for playing on a computer), streaming (for transmission via the Internet or playing on PDAs) and MPEG-2 (for DVD recording DVD).

- **Title recordings in a production**

Possibility of including text on recordings compiled in video productions.

- **Drawing on stored video frames**

Draw or write notes on frames taken from stored videos.

- **Image editor**

Draw or write notes on any stored image file.

- **Extract frames in high or low quality (.bmp o .jpg)**

Possibility of saving any video frame by selection one of 2 options: .bmp format (high quality, larger size) and .jpg format (low quality, smaller size)

- **Extract frame sequences**

Possibility of saving a video sequence in the form of frames, by selecting the number of images to be included.

- **Simple DVD to AVI conversion**

Complete conversion of a DVD to AVI format for analysis with Nac Sport software.

- **Fixed categories**

22 preset event recording categories predefined by professionals in each field, to facilitate generic analysis.

- **Categories set by the user**

Creation of up to 10 recording categories tailored to the needs of each user.

- **Unlimited numbers of groups of categories of user**

Creation of unlimitless number of groups of categories being able to publish as much appearance as the configuration of the parameters of registry of each one of them adjusting to the necessities of each user.

- **.nac data export and import**

Creation of .nac files to share analyses among Nac Sport product licence holders.

- **Microsoft Excel data export**

Creation of .xls files of all the statistical-numerical data related to recorded events, compatible with Microsoft Excel.

- **Database management**

Access to the general list of analysed videos for easy management.

- **Recording time configuration**

Definition of recording time before and after each recorded event.

- **Quick access to any video**

Immediate direct access to all recorded videos from a single, common window.

- **Independent video player**

Video playing directly form Nac Sport software.

- **Total video control**

Control of all video playing functions (10 different playing speeds, pause, playing frame by frame forward and backward, generation of a continuous play loop, full screen viewing, etc) through multiple forms and commands.

- **Statistical information of an observation**

Statistical-numerical information relating to all recorded data (length and number of recordings, percentages, etc.), technical audio and video data and all the initial data entered before the observation.

- **Floating windows on extended desktop**

Independent windows tailored to the user´s tastes and requirements, which can be used on an extended desktop (secondary monitor or projector).

13.3. Designing and developing a new and specific software

In order to manage quicker the big amount of data collected and stored, using the NAC software, we recently designed and developed a new software, the "I.A.C." (fig. 2) which implemented new tools and a more powerful database,

Fig. 2 – I.A.C. Database and Video tools.

This software, that can work in pair with the NAC, was designed with the precise purpose of expanding the possibility of processing the data collected in different matches or tournament, in order to analyze a larger sample of the different variables observed.

The possibility of efficiently linking the different databases, originated for each observed match by the NAC software, is the most useful and powerful feature of our programme, which implemented also many graphic and video tools, in order to better visualize and analyze the observed match. The possibility of discrete and fast researches inside the big amount of collected data (considering that the size of the video files originated by analyzing a major tournament is about 60 Gigabytes with thousands of indexed frames related to the specific categories of the designed observational plan) let us to go deeper and deeper inside the possible investigated topics.

Some specific features of the IAC software are reported below:

- **Presentation of lists of events**

 Direct access to all lists of events for management and viewing on a floating window video player.

- **Comparison of events and videos**

Comparison of two up to four events from the same or different videos frame by frame by means of an independent or simultaneous control (fig.2).
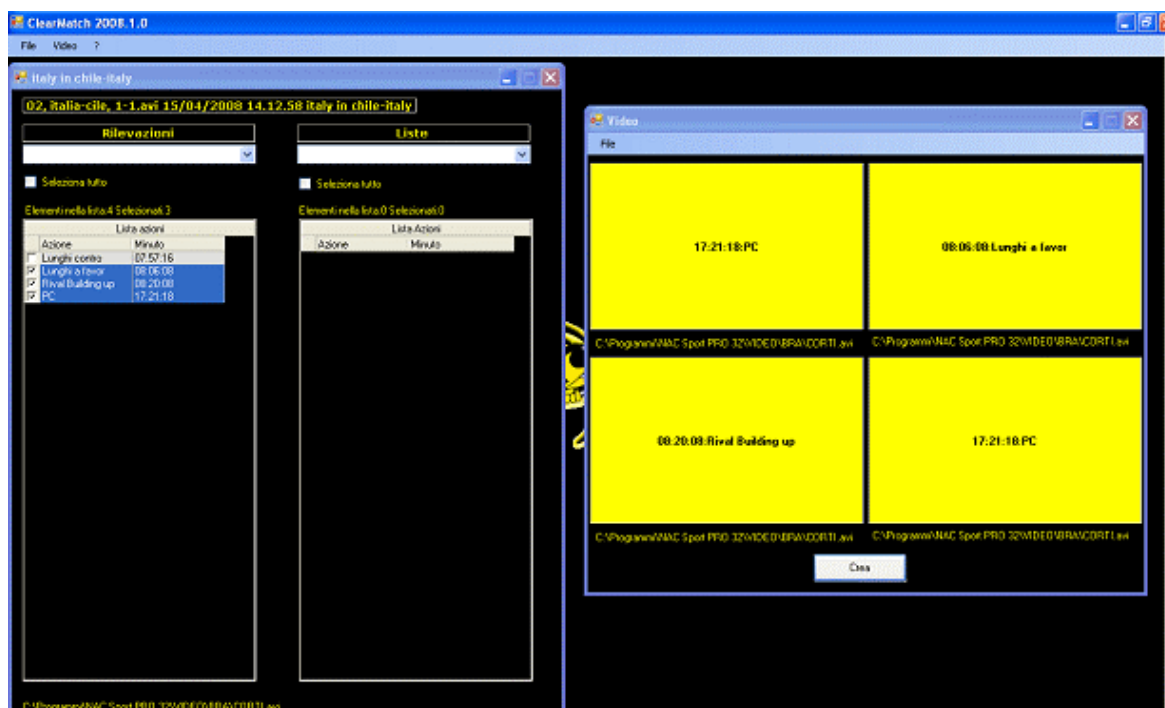
Fig. 2 - A specific tool designed in order to allow analysis over up to four different videoclips at the same time

- **Drawing on stored video frames**

Draw or write notes on frames taken from stored videos.

- **Image editor**

Draw or write notes on any stored image file.
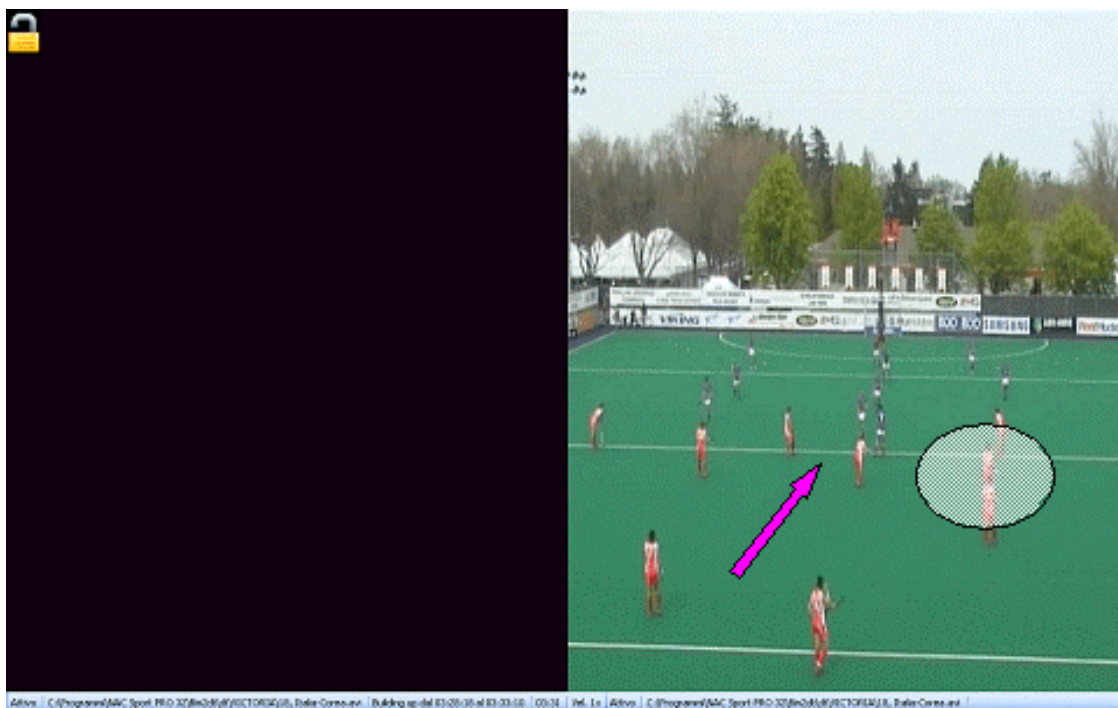
- **Database management**

Access to the general list of all the analyzed videos for an easier and faster management of the collected data.

- **Quick access to any video compiling specific play-lists**

Immediate direct access to all recorded videos from a single, common window (Play-list feature).

13.4. Analyzing the data

Some Data Mining routines, namely the "SPSS Classification Trees™ 13.0" and the "AdaMSoft 2006-2008 – CASPUR", [SPSS inc. ,2004; CASPUR, 2008] were also used to manage efficiently these databases, in order to find the relevant predictors of performance.

All the Penalty Corners performed during the Tournament were taped, indexed and qualitatively analyzed and assessed (see Table 1 and 2), using the NAC Sport PRO32 ® and the I.A.C. software.

Outcome (Dependent Var.)	Strike Type (Independent Var.)	Goal Sectors (Independent Var.)	Defensive System (Independent Var.)	Defensive Positioning (Independent Var.)
0=not valid	0= not executed	0=not valid	0=nondescript	0=nondescript
1=goal	1= direct hit	1= bottom right GK	1= 2:2	1=low
2=saved by GK	2=direct flick	2=bottom centre	2= 3:1	2=intermediate
	3=switch to the back line	3=bottom left Gk	3=2:2 var. in 3:1	3=high
	4=left switch flick	4=middle right Gk	4=3:1 var. in 2:2	
	5=left switch drive	5=middle centre		
	6=right switch flick	6=middle left Gk		
	7=right switch drive	7=top right Gk		
	8= deflection	8=top centre		
		9=top left Gk		

Table 1 - Qualitative Variables and Legend

7	8	9
4	5	6
1	2	3

Table 2 - The Goal divided into 9 Sectors

Trough an inverse analysis, namely beginning from the analysis of the final outcomes of attacking Penalty Corners, we tried to obtain the critical information about the more vulnerable goal sector of the defending team and the weakest defensive system adopted during this peculiar "set pieces" situation.

In order to assess qualitatively the observed Penalty Corners (PC) we decided to analyze them using these Nominal Variables:

a. the **Final Outcome (as the dependent variable)**, assigning these typical values to each PC performed:

    0. not valid (for whatever reason)

    1. a goal scored

    2. saved by Goalkeeper

b. the **Strike Type (as an independent variable)**, referring to the technical skills performed by the attackers:

    0. not executed (for whatever reason)

    1. a direct hit after the "stop"

    2. a direct flick or push after the "stop"

    3. a switch to the back line, both to the right or left of the Goalkeeper;

    4. flicking from a switch to the left of the attacking receiver

    5. hitting from a switch to the left of the attacking receiver

    6. flicking from a switch to the right of the attacking receiver

    7. hitting from a switch to the right of the attacking receiver

    8. deflection close to the Goalkeeper

c. The **Goal Sectors (as an independent variable)**. We considered the goal divided into 9 different sectors, (see table 2) namely:

    0. not valid (for whatever reason)

    1. at the bottom, to the right of the Goalkeeper

    2. at the bottom, in the middle of the goal

    3. at the bottom, to the left of the Goalkeeper

    4. at middle, to the right of the Goalkeeper

    5. at middle, in the centre of the goal

    6. at middle, to the left of the Goalkeeper

    7. at the top, to the right of the Goalkeeper

    8. at the top, in the middle of the goal

    9. at the top, to the left of the Goalkeeper

d. The **Defensive System (as an independent variable)**. Of course there are manifold systems adopted by the teams in order to defend the goal during Penalty Corners. We decided to categorize four basic systems, according to the movement of the four defending players (with the exception of the goalkeeper), assigning these typical values to this variable:

   0. not descript (for whatever reason)

   1. **2:2** (when two defenders are set to each side of the goalkeeper and keep this formation throughout the ongoing Penalty Corner)

   2. **3:1** (when a defender is set to a side of the goalkeeper, while the other three are defending the other side (usually the left side of the goalie) and keep this formation throughout the ongoing Penalty Corner)

   3. **2:2 varying in 3:1**. (when two defenders are set to each side of the goalkeeper in their starting position, but they vary this system during the Penalty Corner, ending in a **3:1** formation)

   4. **3:1 varying in 2:2**. (when the defenders started in a **3:1** position, but they vary this system during the Penalty Corner, ending in a **2:2** formation)

e. The **Defensive Positioning (as an independent variable).** We considered three different modalities in which the Defensive Systems were performed. We considered the spatial positioning of the defensive players, with the exception of the Goalkeeper:

   0. nondescript (for whatever reason)

   1. low positioning. The 4 defenders chose to protect the space close to the goalkeeper

   2. intermediate positioning. The 4 defenders, and especially the front runner/s decide not to attack aggressively the opposing strikers

   3. high positioning. The 4 defenders, and especially the front runner/s decide to attack aggressively the opposing strikers

13.5. Using a Data mining routine: a new perspective to obtain knowledge

In order to find the possible associations between the dependent variable (the final outcome) and the independent ones (the strike types, the goal sectors, the defensive system and the defensive positioning) the "classification tree" procedures of Data Mining were applied [SPSS inc., 2004].

Data Mining encompasses tools and techniques for the "extraction or mining of knowledge from large amounts of data" *[Han and Kamber, 2001]*, in order to find patterns and relationships within data that can possibly result in new knowledge. Furthermore, these relationships can also result in predictors of future outcomes.

13.6. Results

These results were obtained processing the data referred to all the Penalty Corners performed in sixteen games out of the eighteen played by all the teams participating in the last Women Olympic Qualifiers held in Canada (April-May 2008) and qualitatively analyzed by the authors.

The important role played by the "set pieces" situations, particularly attacking and defending penalty corners, confirmed what is stressed during the training sessions from a traditional coaching point of view, *[Whitaker, 1992; Laird and Sutherland, 2003]* where these particular aspects of the game seem to influence heavily the final result in competition (see table 3 and 4).

	N	%
Total Field Goals	29	49,15%
Total PC Goals	29	49,15%
Total PS Goals	1	1,69%
Total Goals	**59**	

Table 3 - From Women Olympic

Qualifiers, Canada 2008

	Final Scores (goals)	Field Goals	Penalty Corner Goals	Penalty Stroke Goals
Game 1	10-0 =10	6	4	0
Game 2	2-1 = 3	1	2	0
Game 3	3-0 = 3	1	2	0
Game 4	4-0 = 4	0	3	1
Game 5	2-0 = 2	0	2	0
Game 6	5-0 = 5	2	3	0
Game 7	1-0 = 1	0	1	0
Game 8	5-0 = 5	4	1	0
Game 9	1-0 = 1	1	0	0
Game 10	5-1 = 6	3	3	0
Game 11	0-0 = 0	0	0	0
Game 12	5-0 = 5	2	3	0
Game 13	3-0 = 3	2	1	0
Game 14	4-0 = 4	3	1	0
Game 15	2-0 = 2	1	1	0
Game 18	5-0 = 5	3	2	0
Totals	**59**	**29**	**29**	**1**
Mean		**1,81**	**1,81**	**0,06**
SD		**1,68**	**1,17**	**0,25**

**Table 4 – Goals scored during the Victoria Tournament
Descriptive Statistics**

Particularly interesting were the results obtained processing the data collected evaluating defending and attacking Penalty Corners, using a **Data Mining** specific tool, denominated "**Classification Tree**", able to provide some predictors of performance.

The Tree Diagram shown in fig. 3) is a graphic representation of the **Tree Model**.
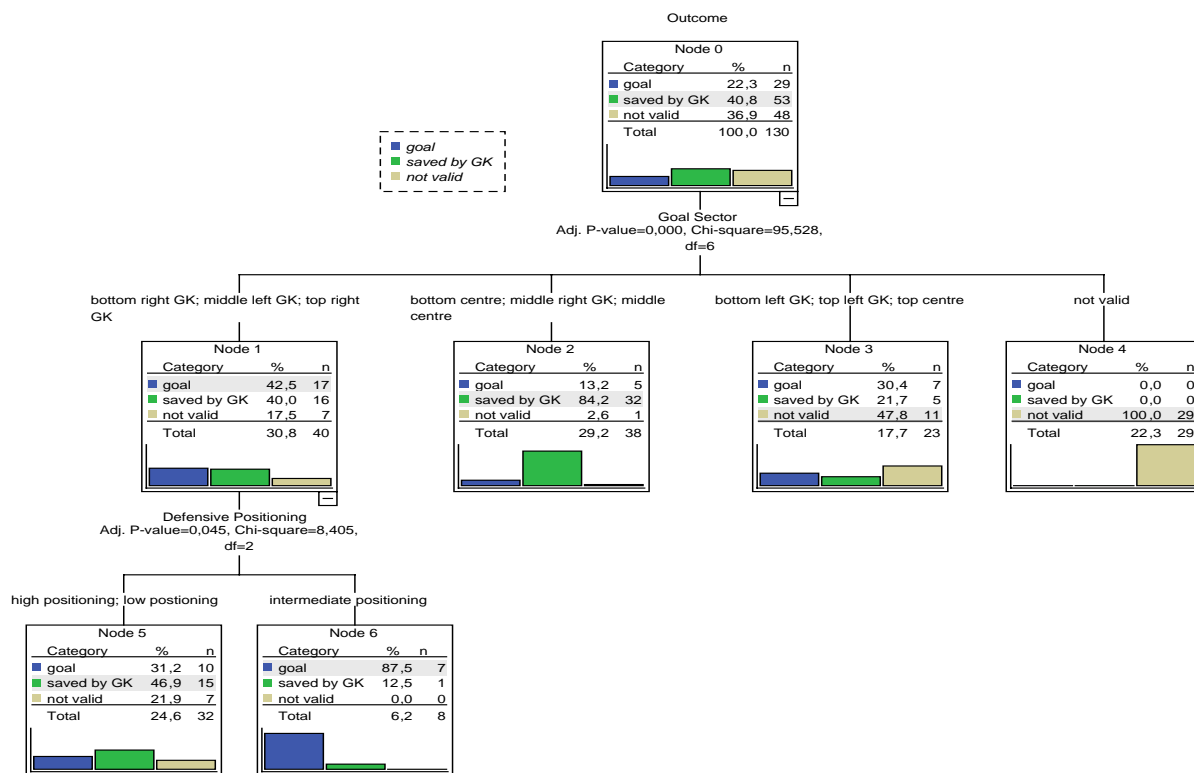
Figure 3 - The Tree Diagram or Classification Tree, by SPSS 13.0

13.7. Discussion

The Tree Diagram Method shown in figure 3 underlines that using the CHAID method (Chi Square Automatic Interaction Detection), the **Goal Sector** (independent variable) is the best predictor of the **Outcome** (dependent variable):

- with a possible prediction of 42.5% goal scoring success if the sectors "Bottom Right to GK, Middle Left to GK or Top Right to GK" are selected by the strikers (node 1); in this case the model also includes one more predictor, the "defensive positioning" (node 5 and 6), which confirms (node 6) the ineffectiveness of an "intermediate positioning" while defending, with a remarkable 87.5% of goal scoring possibility by the attacking team (Chi-square values are provided).

- for nodes 2 and 3, Goal Sector is the only significant predictor of Outcome. Since there are no child nodes below them, these are considered as terminal nodes.

13.8. Data Mining and Knowledge Discovery in Sports Data. A case study from the NBA5

A Data Mining software, integrated with a video match analysis software, can seek out and discover interesting patterns in game data, like the ones we found in the above mentioned case study.

With this information, a coach can assess the effectiveness of certain coaching decisions and formulate game strategies for subsequent games, thus improving effectively the quality of his/her training coaching methods.

Already in the 1995-96 season, a similar software (Advanced Scout – AS) had been distributed to sixteen of the twenty-nine NBA teams. While some of the teams were at the early stages of evaluating its use, others (i.e. New York Knicks, Orlando Magic, Seattle Supersonics) quickly integrated the software into their game preparation and analytical processes. The positive feedback received from coaching staffs indicated that it has been a valuable tool. The famous basket coach Bob Salmi (while at the NY Knicks), likened it to having another coach on the team. It has also been well received by the NBA because it contributes to improving the

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[5] NBA – National Basket Association - USA

quality of play, which provides additional value to fans of the game (McMurray, 1995; Sterba, 1996).

13.9. Data collection

In that research the raw data from NBA games was initially collected using a specialized system designed for logging basketball data. Data include:

- who took a shot,
- the type of shot,
- the outcome,
- any rebounds, etc.

Each action was associated with a time code. At the end of each game, the data were uploaded and stored on an electronic bulletin board. Any team was able to access and retrieve the data of any other team from this billboard. A copy of the data had to be downloaded into Software AS for analysis.

13.10. Data pre-processing: Cleaning, transformations, and enrichment

After the data have been downloaded, AS performed a series of consistency checks to ensure that the data are as accurate as possible before any analysis occurs. There are various aspects to data cleaning (Redman, 1992; McDonald and Celko, 1995). In AS, consistency checks were designed to detect errors made during the data collection process. A data error was a missing action or an impossible event. Corrections were made using a rule base, and/or with the input of a domain expert (typically a coach). For example, if two shots appeared to be taken in quick succession without anyone credited with a rebound, the program would assume that the person taking the second shot also rebounded the ball. If needed, corrections were verified via video tape. After the consistency checks, the data were transformed and reformatted. This was to facilitate a coach's inspection of raw data and to define an appropriate unit of analysis that was consistent with their perspective. AS reformatted the raw data of discrete events into a **play-sheet** - a standard form in which an event description and time are listed sequentially. Since coaches were very familiar with the play-sheets, they were able to quickly examine the discrete events of a game. From coaches' input, they discovered that the

appropriate unit of analysis was an **entire possession**, composed of the actions and sub-events that preceded a shot attempt, rather than the elementary discrete events. Therefore additional transformations were made to group events into possessions.

Data enrichment referred to the use of additional information to add value to analysis.

Data were enriched through by inference rules and additional data entry. The role of each player on the court (e.g. power forward, 1-guard, etc.) was inferred by AS based on information in a player-role table. These inferences allowed useful analyses of player-role relationships. Often, the plays a team decided to use were related to the players and their roles. Every team had a set of plays and many of a team's possessions were based on a specific play. Analyses of the circumstances surrounding the success or failure of their plays was therefore important. Because a team's plays were confidential and unknown to those logging the data, the play call information was not part of the raw data. The play call information was entered by the coach of the team, drawing from a separate, and confidential data source.

13.11. Data mining

Data mining can be viewed as the automated application of algorithms to detect patterns in data. (Fayyad, Piatetsky-Shapiro, Smyth, 1996).

In AS, a coach was able to initiate a general data mining query in which the program would automatically search for interesting patterns for either the home or opposing team using either field goal shooting percentage to detect patterns related to shooting performance, or possession analysis to determine optimal lineup combinations.

Subsequent analyses might include more specific queries in which other attributes and conditions were specified. The algorithms that underlied the data mining aspects of AS used a technique called **Attribute Focusing** (AF), (Bhandari, 1995).

An overall distribution of an attribute is compared with the distribution of this attribute for various subsets of the data. If a certain subset of data had a characteristically different distribution for the focus attribute, then that combination of attributes, (the conditions that define the subset) were marked as **interesting**.

 Early applications of this technique were applied to software process engineering (Bhandari, 1993) and it has been extended as the data mining technique used in

AS. In the AF algorithm, an **"interesting event"** can be described more formally as the following:

An "event", E is a string $En = x_1; x_2; x_3; : : : ; x_n;$

in which x_j is a possible value for some attribute and x_k is a value for a different attribute of the underlying data.

E is interesting to the extent that x_j 's occurrence depends on the other x_i's occurrence. The interestingness measure used by AS is the size $I_j (E)$ of the difference between:

      (a) the probability of E among all such events in the data set and,

      (b) the probability that $x1; x2; x3; : : : ; x_{j-1} ; x_{j+1}; : : : ; x_n$ and x_j
   occurred independently.

A first condition of Interestingness exists only if $I_j (E) > D;$ where D = some fixed threshold. When set at an appropriate level, this removes "false positives".

A second condition of Interestingness depends on finding an optimal number of attribute values, n, formally described as

$I_j(E_n) > I_j (E_{n-1});$ and $I_j (E_n) >= I_j(E_{n+1});$ where $E_n = x_1; x_2; x_3, : : :, x_n.$

So, AF seeks to eliminate all but the most interesting events by keeping E only if the number of attribute values, n, is optimal: eliminate one or more x_i's, and I_j decreases, include one or more new x_i's to the string and I_j gets no larger. The convergence to an n removes patterns (an E_{n-1}, or E_{n+1}) which are less interesting than E_n, and have information already contained by E_n. Consequently, the user need not have to drill-down or drill-up from a highlighted pattern because the event descriptions returned by the algorithm are at their most interesting level.

13.12. Interpretation and knowledge discovery

The results of data mining were presented to the user in two forms - a text description and a graph (omitted here). Automatically generated text described the patterns. An example reported:

"When Price was Point-Guard, J.Williams missed 0% (0) of his jump field-goal-attempts and made 100% (4) of his jump field-goal-attempts. The total number of such field-goal attempts was 4. This is a different pattern than the norm which shows that: Cavaliers players missed 50.70% of their total field-goal-attempts. Cavaliers players scored 49.30% of their total field-goal-attempts."

The objective of such a presentation was to ensure that the results were easily understood by a coach. (A point-guard is a basketball term that refers to the player responsible for bringing the ball up the court and directing the offense). The text presentation also offered a suggestion as to why the particular pattern was interesting - explicitly pointing out the ways that this particular pattern deviated from an expected norm - in essence presenting an initial argument and easily interpretable justification of Interestingness.

A subsequent requirement of knowledge discovery would be for the domain expert to determine the underlying cause of this pattern. (What was revealed in this particular case was that when the Knicks put two players on Price, he successfully found Williams unguarded for a jump shot). The process of interpreting patterns represented **knowledge discovery,** and traditionally required activity on the part of a domain expert. In AS, pattern interpretation was facilitated by providing the user with several opportunities for further interactive analysis to gain additional contextual information. Perhaps the best opportunity to interpret a pattern is via video tape of the actual events. AS presented the video times for every interesting pattern. Coaches then were able to view just those segments of video tape. The video tape provided the complete context surrounding an interesting pattern and coupled with the perceptive abilities of a domain expert, interpretation and knowledge discovery is greatly facilitated. In the most recent version of AS, an entire game can be stored on a CD-ROM and the relevant segments can be isolated, accessed and viewed on a PC itself. Current trends to digital video should make this more cost effective and more prevalent in the near future.

13.13. Conclusions

This case study evidenced the great potential of the Video-Computerized Match Analysis Systems, combined with the Data Mining tools, in providing a sound theoretical background to design training methods aimed at improving the tactical aspect of the game, especially in "set pieces" situation.

Possible applications of this combined methodology (video-match analysis and data mining) could be seen in most of team sports, where the "set pieces" situations occur frequently and very often they represent important features of the game. Obviously such approach could be usefully applied to "open play" situations too (e.g. spatial or temporal patterns recognitions, best trajectories of passing, running, striking, etc.).

The sports world is commonly recognized for the large amounts of statistics concerning quite all the aspects of the games or athletic disciplines. This can result in information overload for those trying to derive useful meanings from statistics. Hence, sports are ideal for data mining tools and techniques. Of course Data Mining is a tool that can be used in order to help in the decision making processes that they undertake.

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Conclusions

This long journey through the world of Match Analysis has finally come to a…provisional end.

The need for more and further investigations, mostly about the third level of analysis (*General Strategy and Tactic, see chapter 9)* is highlighted throughout this thesis. However we can afford to draw some conclusive statements, that may be useful for future researches.

In these three years I had the opportunity to visit many countries, in order to participate in important sport events, such as the European Championships, the World Cup Qualifications, the Olympic Qualifications and also in a great number of Test Matches and Tournaments.

As the Technical Director of the Italian Hockey Teams since 2004, I had the immense privilege to work with the Coaches and the *Match Analysts*, either of the Italian teams or from the opposing teams, discussing theories, sharing experiences and, above all, using Match Analysis tools and equipment, software and videos the most. What I finally learnt is that a new age for the *Match Analysis Process* has just begun *(see chapter 2)*. We found that the match analysis procedures are becoming increasingly more sophisticated and complex, mirroring quite closely the rapid developments in technology, in Information and Video Technology the most. The future scenarios are beyond our present capacity of prediction but an immediate need is already raising among the experts and sport insiders: we do need a high level of qualification for the people working on this side of Sport *(see chapter 11)* and the Universities are probably going to give an answer to the increasing demand of this specific training dedicated to the match analysts.

Team Sports Match Analysis procedures have been investigated, applied and assessed, even in top sports environments, such as the Olympic Field Hockey or the professional footballers performing in the Italian "*Serie A" (see chapters 7, 9, 13).*

In our studies we ranged from the use of sophisticated equipment, such as the VICON 612® photogrammetric system (*chapter 7*) or the commercial Video

Match Analysis Software "NAC" (*chapter 13*) to the use of simpler tools, such as an amateur video camera and a laptop *(chapter 9)* that, nevertheless, provided sound results, having processed through the appropriate statistics the relevant data *(see chapter 12)*, collected according to scientific systematic observation guide lines *(see chapter 10)*.

Generally speaking, the impact of the Match Analysis procedures has to be framed into the general scenario of Training Methodology *(see chapter 4)*, involving different disciplines that combine to provide an interdisciplinary approach*,* considered necessary to go deep into the real core of Team Sports *(cfr. Brettscheinder, 1990, in chapter 5)*.

The contributions provided by Mathematics, Physics and Economics seem to be particularly promising *(see chapter 5 and 12)*, whereas applying different mathematical models it is already possible to study specific relevant features in Team or Situation Sports (see chapter 9) or to provide the appropriate formulas describing the Motion Equations, the Acting Forces, etc. *(cfr. Sacripanti in chapter 6)*.

Future lines of research concerning the Match Analysis process will probably develop the applications provided by the recent acquisitions of the Artificial Intelligence studies, mainly the Data Mining procedures and the Virtual Reality *(see chapter 8)*.

As described in *chapter 13*, we used a combination of three different software systems, including a Data Mining, in order to analyse a crucial performance in field hockey, the penalty corner.

We applied this Data Mining routine to find the possible associations between the dependent variable (the final outcome) and the independent ones (the strike types, the goal sectors, the defensive system and the defensive positioning).

These associations are also called *"predictors of performance"*.

The obtained results are encouraging since the predictions obtained matched the ones independently made by the coaches during the World Women Hockey Olympic Qualifier held in Canada in 2008, confirming the effectiveness of such an approach for future researches.

UNIVERSITÀ DEGLI STUDI DI ROMA "TOR VERGATA"

FACOLTA' DI MEDICINA E CHIRURGIA

DOTTORATO DI RICERCA IN

SCIENZE DELLO SPORT

CICLO DEL CORSO DI DOTTORATO

XXI

Titolo della tesi

MATCH ANALYSIS IN TEAM SPORTS

Appendice di Ricerca:

Research Posters
Review of the relevant literature

DOTTORANDO: BRUNO RUSCELLO

A.A. 2008/2009

Tutor: Prof. *ATTILIO SACRIPANTI*

Coordinatore: Prof. *ANTONIO LOMBARDO*

A 3D kinematics analysis of the field hockey pushing while in a stationary position.

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Introduction

Field Hockey is a very popular outdoor stick and ball team sport. Its technical performance is heavily affected by the proper use of its distinguishing tool, the stick. In order to control, lead, and propel the ball, various techniques have been developed and trained by coaches and players, with the aim to improve speed, power, and precision in all the aspects of the game. Pushing the ball is considered one of the real basic skills of this sport, particularly with the ever-increasing use of artificial turf.

In this case study, the 3D kinematics of the push technique used in stationary ball situations was analysed to detect crucial features to be considered in training to improve precision, while keeping the operating speed consistent with the competitive needs of the game.

The push

During the stroke, the body weight transfers from the right to the left foot without rising; the hands are placed apart on the stick and, as the right arm pushes forward, the left hand pulls the top of the handle backward causing the head of the stick to accelerate. The right arm controls the pass, keeping in line with the ball trajectory.

Materials and Methods

An elite male hockey player (international level) performed 50 pushes, with the aim of hitting a target (0.15 x 0.10 m) placed at 2.5 m from him. Data were acquired with a 9 camera VICON 612® photogrammetric system.

Fig. 1 – Starting position and marker set: full body conventional PlugIn Gait on the body, 4 markers on the stick, 3 on the target.

The value at the impact with the ball and the maximal value of knee flexion-extension, hip angular kinematics, pelvis and shoulder angular velocity, pelvis-shoulder angle and stick velocity (showed in Figure 3) were considered to predict a dichotomous hit variable using a logistic regression.

Results

The abduction and flexion angles of the left hip proved to be the most significant predictors of the hit, followed by the angular velocity of the shoulder and, consequently, by the linear velocity of the head of the stick. The important role played by the correct positioning of the lower limbs and hips in obtaining precision using this technique confirmed what is stressed during the training sessions from a traditional coaching point of view as result of experience, and qualitative biomechanical analysis performed in good coaching practice.

		fe_K	fe_H*	aa_H*	ie_H	v_{ST}*	α_{PV-SH}	ω_{PV}	ω_{SH}*
		deg	deg	deg	deg	m/s	deg	rad/s	rad/s
max	mean	59.7	47.3	38.0	22.0	13.0	24.5	7.0	8.2
max	st dev	4.2	5.5	10.7	12.0	2.2	7.8	1.5	1.3
impact	mean	53.4	38.3	36.5	19.1	5.2	21.2	4.5	5.8
impact	st dev	8.4	6.1	6.6	5.9	1.9	3.3	1.9	2.2
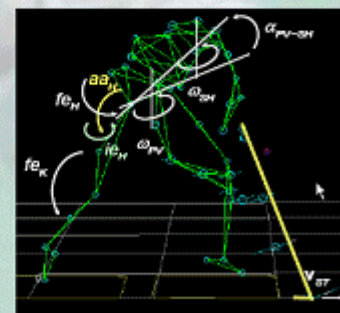
Significant predictors of the hit variable are indicated with a *

Discussion and Conclusions

This case study evidenced the potential of a 3D kinematics analysis in providing a sound theoretical background to design a training method aimed at improving this crucial technique. Further studies, including more elite subjects and a non-elite population, are required to generalise these results and to confirm or refute common coaching points of view on this technique.

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Match Analysis in Field Hockey
Information and training: the winning duet

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Introduction

Match Analysis is a major issue among coaches, team managers and sport scientists. Information and information processes are the key factors while referring to this aspect of sport methodology.

Most of the information available in field hockey is referred to the bio-energetic aspects of the game and some of the biomechanics of the complex technique of this sport. Few researches are available referring to the tactical aspects of the game although this issue is felt extremely important by the vast majority of the coaches, at all levels.

Our aims were to describe, test and define a methodology of Video-Computerized Match Analysis System, applied to Field Hockey, able to support consistently the work of coaches in assessing qualitatively the team performance and, by the means of Data Mining, describe the relevant patterns which could characterize a specific team in its tactical features.

In this case study, the inner tactical structures of the Italian Senior Women Hockey Team were analyzed to detect the crucial features to be considered in training. The relevant data were processed even for the opposing teams in order to cope efficiently with this issue, while playing the best teams in the world, involved in European and World events.

Materials and Methods

A commercial software of video-match analysis, (**NAC Sport PRO 32®**) *(fig. 1)* and a **new software** were used. The latter, recently designed and developed by the authors, implemented new tools and a more powerful database, in order to manage quicker the big amount of data collected and stored *(fig.2)* by the NAC software.

Some **Data Mining** routines were also used to manage efficiently these databases *(fig. 3- Tab. 2-3)*.

The presented data were collected at the Olympic Women Qualifier, Victoria (Canada) April-May 2008.

Fig. 1)

Fig. 2)

Seq. 1)

Results

The important role played by the "set pieces" situations (Seq. 1), particularly attacking and defending Penalty Corners (PC), confirmed what is stressed during the training sessions from a traditional coaching point of view, where these particular aspects of the game seem to influence heavily the final result in competition (see table 1).

Particularly interesting were the results obtained processing the data collected evaluating defending and attacking Penalty Corners, using a Data Mining specific tool, denominated **"Classification Tree"** (fig.3), able to provide some predictors of performance.
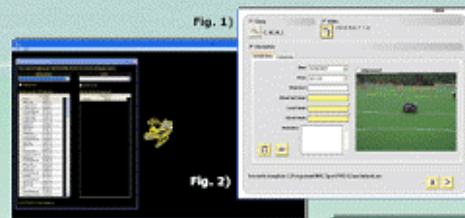
	N	%
Total Field Goals	28	48.28%
Total PC Goals	29	50.00%
Total PS Goals	1	1.72%
Total Goals	58	

Tab. 1) From Women Olympic Qualifiers, Canada 2008
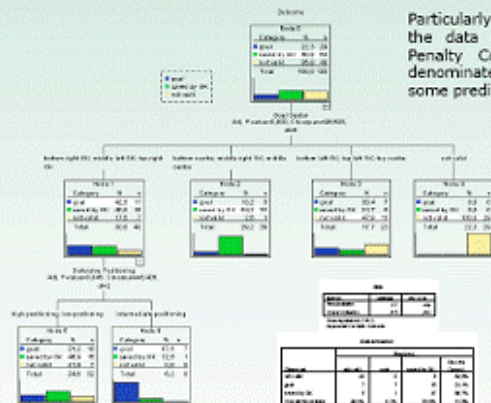
Fig. 3)

Tab. 2-3)

These results were obtained processing the data referred to all the Penalty Corners performed by all the teams participating in the last Women Olympic Qualifiers held in Canada (April-May 2008) and qualitatively analyzed by the authors.

The Tree Diagram (fig. 3) is a graphic representation of the Tree Model. This Tree Diagram shows that:

Using the **CHAID** method (Chi Square Automatic Interaction Detection), **Goal Sector** is the best predictor of the **Outcome**:

- with a possible prediction of 42.5% goal scoring success if the sectors "Bottom Right to GK, Middle Left to GK or Top Right to GK" are selected by the strikers (node 1); in this case the model also includes one more predictor, the "defensive positioning" (node 5 and 6), which confirms (node 6) the ineffectiveness of an "intermediate positioning" while defending, with a remarkable 87.5% of goal scoring possibility by the attacking team (chi-square values are provided).

- for nodes 2 and 3, **Goal Sector** is the only significant predictor of **Outcome**. Since there are no child nodes below them, these are considered as **terminal** nodes.

Discussion and Conclusions

This case study highlighted the great potential of the Video-Computerized Match Analysis Systems combined with a Data Mining tool in providing a sound theoretical background to design training methods aimed at improving the tactical aspect of the game.

Further studies, including more elite subjects and a non-elite population, are required to generalize these results and to confirm or refute the common coaching points of view on this issue.

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Appendice di ricerca svolta sul Repertorio Mondiale SportDiscus

Contents

TI: Goal scoring patterns over the course of a match: an analysis of the Australian National Soccer League

DE: SOCCER-; AUSTRALIA-; MATCH-ANALYSIS; STATISTICS-; EVALUATION-
SH: (576177) SOCCER STATISTICS-AND-RECORDS; (902050) COACHING-EVALUATION
ITSH: (576177) CALCIO STATISTICA; (902050) ALLENAMENTO-VALUTAZIONE

Record 2 of 281 - SPORT Discus

TI: Types of goals scored over the course of a match: An analysis of the Australian national soccer league - abstract

AU: Abt,-G-A; Dickson,-G; Mummery,-W-K; Rowsell,-G
DE: SOCCER-; MATCH-ANALYSIS; SCORING-; GOAL-KICK; EVALUATION-STUDY; ELITE-ATHLETE; AUSTRALIA-
SH: (576180) SOCCER STRATEGY; (576288) SOCCER TECHNIQUES-AND-SKILLS-SHOOTING
ITSH: (576180) CALCIO TATTICA; (576288) CALCIO TECNICO-TIRO

We have previously reported that goal scoring in soccer is time dependent (Abt et al., 1999). The mechanisms involved in this phenomenon are most probably multifactorial, although physical and mental fatigue appear to contribute to the process. Given this link, it is tempting to suggest that as a match progresses, an increase in the frequency of penalties and own goals would be observed, due to an increase in the number of mistakes made. Additionally, previous research has identified that 77% of the goals scored in the final 15-minute period either give or confirm a win. To address these issues in an Australian context, five seasons of the Australian national soccer league (1994/95 - 1998/99) were analysed. The analysis was conducted in two parts: (a) all goals scored across the five seasons (n = 2670) were analysed to determine the frequency of penalty and own goals scored per 15-minute period and (b) the last goal scored in the final 15-minute period of each match (n = 422) was identified to determine the effect of that goal on the outcome of the match. A normal goal was defined as one being scored from general play; a confirmatory goal was defined as being one which increased a teams lead and a consolation goal was defined as being one which decreased the difference between the two teams. Results revealed an increase in the frequency of penalty goals scored in the second half (n = 101) compared to the first half (n = 55). There was little difference in the frequency of own goals scored across time periods. The second analysis revealed that during the final 15-minute period, the frequency of winning, drawing, confirmatory and consolation goals were 112, 68, 174 and 68 goals, respectively. An increase in the frequency of penalty goals scored in the second half suggests that players are either taking more risks in defence during this period, or that there is an increase in the number of technical errors leading to fouls being committed in the penalty area. The results of the second analysis confirm those of previous research, with 68% of those goals identified from the final 15-minute period of the match either giving or confirming a win. Alternatively, 57% of those goals identified from the final 15-minute period had no effect on the outcome of the match. The frequency of confirmatory and drawing goals identified during the final 15-minute period may help to explain the suggestion that a losing team engages in riskier play toward the end of a match in order to score. However, the results of the present study show that more confirmatory goals are scored than drawing goals during the final 15-minute period, creating doubt as to the efficacy of such a strategy

Record 3 of 281 - SPORT Discus

TI: Coaches learn to use video analysis

DE: BIOMECHANICS-; VIDEOTAPE-; VISUAL-FEEDBACK; FREESTYLE-SKIING; SYNCHRONIZED-SWIMMING
SH: (420027) SYNCHRONIZED-SWIMMING BIOMECHANICS; (514027) FREESTYLE-SKIING BIOMECHANICS; (946850) BIOMECHANICS-TECHNIQUE
AB: This article explains how the author "used video analysis to enhance performance in acro skiing and in synchronized swimming. Finally, I'll give practical advice for doing your own video analysis in any sport."
ITSH: (420027) NUOTO-SINCRONIZZATO BIOMECANICA; (514027) SCI-ACROBATICO BIOMECANICA; (946850) BIOMECCANICA-TECNICA

Record 4 of 281 - SPORT Discus

TI: Quantitative video analysis: a major coaching tool

AU: Allison,-T; Allinger,-T
SO: Coaches-report-(Ottawa) 5(4), Spring 1999, 20-23, Total No. of Pages: 4
PY: 1999
LE: Advanced
DE: COACHING-; VIDEOTAPE-; VISUAL-FEEDBACK; BIOMECHANICS-; FREESTYLE-SKIING; EVALUATION-
SH: (514027) FREESTYLE-SKIING BIOMECHANICS; (514310) FREESTYLE-SKIING TESTING-AND-EVALUATION; (900750) COACHING-BIOMECHANICS
ITSH: (514027) SCI-ACROBATICO BIOMECANICA; (514310) SCI-ACROBATICO TEST; (900750) ALLENAMENTO-BIOMECCANICA
CL: GV711.P4 #761
SX: This document is available via SIRCExpress Order Number S-44205, https://secure.sportquest.com/su.cfm?articleno=S-44205&title=S-44205

Record 5 of 281 - SPORT Discus

TI: Timing the selection of information during rhythmic catching

AU: Amazeen,-E-L; Amazeen,-P-G; Post,-A-A; Beek,-P-J
SO: Journal-of-motor-behavior-(Washington) 31(3), Sept 1999, 279-289, Total No. of Pages: 11
PY: 1999
LE: Advanced
DE: CATCHING-; LEARNING-; SKILL-; ATTENTION-
SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS; (971030) PERCEPTUAL-MOTOR-PROCESSES-ATTENTION
AB: Catching a ball requires that information be available close to the catch but early enough for prospective or corrective control. In the present experiment, 6 participants were asked to throw and catch a ball continuously for 1 min while wearing liquid-crystal goggles that restricted viewing to specific amounts of time at specific intervals. Participants were free to select the information by varying the frequency and phasing of throwing relative to the goggles. Video analysis revealed that they elected a frequency of throwing that matched the goggle frequency and chose to view the ball at or around its zenith. Earlier portions of the ball's trajectory were viewed as the goggle frequency increased. Despite variations in the viewing location, participants elected to view the ball on average 365 ms before the catch. Analysis of the hand's trajectory further revealed that the time interval (M = 82 ms) between the ball's zenith and the initiation of the final motion of the hand toward the catch did not vary as a function of the frequency of throwing. The authors conclude that the timing constraints imposed by the hand's movement are the basis for the selection of information for catching.
ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (971030) APPRENDIMENTO-PERCETTIVO-MOTOR-ATTENZIONE
CL: BF1.P4 #40
SX: This document is available via SIRCExpress Order Number S-63389, https://secure.sportquest.com/su.cfm?articleno=S-63389&title=S-63389

Record 6 of 281 - SPORT Discus

TI: Football incident analysis: a new video based method to describe injury mechanisms in professional football

AU: Andersen,-T-E; Larsen,-O; Tenga,-A; Engebretsen,-L; Bahr,-R
SO: British-journal-of-sports-medicine-(London) 37(3), June 2003, 226-232, Total No. of Pages: 7

PY: 2003
LE: Advanced
DE: SOCCER-; INJURY-; MATCH-ANALYSIS; VIDEOTAPE-; MIDFIELD-; OFFENCE-; DEFENCE-; TACKLING-; ATHLETE-; ADOLESCENT-; YOUNG-ADULT; MEDICAL-RECORD; REVIEW-; TEST-RELIABILITY
SH: (576093) SOCCER INJURIES-AND-ACCIDENTS; (992300) RESEARCH-AND-RESEARCH-METHODS-RESEARCH-METHODS

AB: Objectives: To develop and test a new video based method for match analysis that combines football specific and medical information to achieve a better understanding of the injury mechanisms and events leading up to high-risk situations. Methods: Football incident analysis (FIA) is a video based method describing incidents that may result in an injury using 19 variables and categories modified from match analysis. Videos from 35 of 76 (46 %) official Norwegian under 21 matches played from 1994 to 1998 were analyzed. Two football experts classified each incident on the basis of predetermined criteria, and their results were compared using interobserver and intraobserver reliability tests. Results: Kappa correlation coefficients for interobserver and intraobserver agreement were very good for 63 % and 95 % and good for 37 % and 5 % of the variables respectively. Fifty-two incidents were recorded (1.6 incidents per team per match or 94 per 1000 player hours), and 16 (31 %) led to injuries (0.5 injuries per match or 29 injuries per 1000 player hours). FIA results showed that 28 incidents occurred while attacking in midfield zone 2 or the attacking zone, and 24 took place while defending in the defensive zone or midfield zone 1. Midfielders were exposed in 67 % of the incidents, mainly in breakdown attacks or during long attacks by the opposing team. Of the 28 incidents during offence, only one was classified as having great potential to score a goal. Most incidents (70 %) were the result of tackling duels both in the offensive and defensive playing phases. Of the 21 offensive incidents resulting from tackling duels, in 19 cases the exposed player was unaware of the tackling (passive duellist). Conclusions: This study shows that football incident analysis is a potentially valuable tool for understanding the events leading up to injuries in football.
ITSH: (576093) CALCIO INFORTUNI-E-INCIDENTI; (992300)
CL: RC1200 #300
SX: This document is available via SIRCExpress Order Number S-900996, https://secure.sportquest.com/su.cfm?articleno=S-900996&title=S-900996

Record 7 of 281 - SPORT Discus

TI: Video analysis of injuries and incidents in Norwegian professional football

AU: Andersen,-T-E; Tenga,-A; Engebretsen,-L; Bahr,-R
PY: 2004
LE: Advanced
DE: SOCCER-; INJURY-; OCCURRENCE-; RISK-; VIDEOTAPE-; QUESTIONNAIRE-; STATISTICS-; MATCH-ANALYSIS; PROSPECTIVE-STUDY
SH: (576093) SOCCER INJURIES-AND-ACCIDENTS

AB: Objectives: This study describes the characteristics of injuries and high-risk situations in the Norwegian professional football league during one competitive season using Football Incident Analysis (FIA), a video based method. Methods: Videotapes and injury information were collected prospectively for 174 of 182 (96 %) regular league matches during the 2000 season. Incidents where the match was interrupted due to an assumed injury were analyzed using FIA to examine the characteristics of the playing situation causing the incident. Club medical staff prospectively recorded all acute injuries on a specific injury questionnaire. Each incident identified on the videotapes was cross-referenced with the injury report. Results: During the 174 matches, 425 incidents were recorded and 121 acute injuries were reported. Of these 121 injuries, 52 (43 %) were identified on video including all head injuries, 58 % of knee injuries, 56 % of ankle injuries, and 29 % of thigh injuries. Strikers were more susceptible to injury than other players and although most of the incidents and injuries resulted from duels, no single classic injury situation typical for football injuries or incidents could be recognized. However, in most cases the exposed player seemed to be unaware of the opponent challenging him for ball possession. Conclusions: This study shows that in spite of a thorough video analysis less than half of the injuries are identified on video. It is difficult to identify typical patterns in the playing events leading to incidents and injuries, but players seemed to be unaware of the opponent challenging them for ball possession.
ITSH: (576093) CALCIO INFORTUNI-E-INCIDENTI
CL: RC1200 #300
SX: This document is available via SIRCExpress Order Number S-961230, https://secure.sportquest.com/su.cfm?articleno=S-961230&title=S-961230

Record 8 of 281 - SPORT Discus

TI: Uproszczony model probabilistyczny dla szacowania stanow meczowych w pilce siatkowej

Simplified probabilistic model for evaluating game states in volleyball

AU: Aniol,-M; Wagner,-W
SO: Wychowanie-fizyczne-i-sport-(Warsaw) 45(3), Sept 2001, 341-349, Total No. of Pages: 9
PY: 2001
LE: Advanced
DE: VOLLEYBALL-; MATCH-ANALYSIS; PROBABILITY-; WINNING-; THEORETICAL-MODEL
SH: (588110) VOLLEYBALL MATHEMATICS
ITSH: (588110) PALLAVOLO MATEMATICA
CL: GV201 #4340
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-797529, https://secure.sportquest.com/su.cfm?articleno=S-797529&title=S-797529

Record 9 of 281 - SPORT Discus

TI: Simplified probabilistic model for evaluating game states in volleyball

AU: Aniol,-M; Wagner,-W
SO: Wychowanie-fizyczne-i-sport-(Warsaw) 45(3), Sept 2001, 351-359, Total No. of Pages: 9
PY: 2001
LE: Advanced
DE: VOLLEYBALL-; MATCH-ANALYSIS; PROBABILITY-; WINNING-; THEORETICAL-MODEL
SH: (588110) VOLLEYBALL MATHEMATICS

AB: One of characteristic features of volleyball game is playing consecutive sets and deciding the current score according to the results of particular sets. In this way we can examine volleyball game in many stages, but the results of a game are fixed in the third, fourth or fifth stage. Each set creates a temporary state, which occurs with definite probability. It is immediately dependent on accepted foundations of probability of winning a set in every game stage. In the study we analyzed a simplified model. For the needs of this model we draw a tree figure, which describes states of passing sets in a volleyball game. We described also a theoretical model and illustrated its usefulness for interpretation of the results of female I-league from the season 1998/1999 for the team Augusto Kalisz, the winner of the season.
ITSH: (588110) PALLAVOLO MATEMATICA
CL: GV201 #4340
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-797530, https://secure.sportquest.com/su.cfm?articleno=S-797530&title=S-797530

Record 10 of 281 - SPORT Discus

TI: Video analysis of selected game activities in Australian rules football

(Analyde video de sequences de jeu selectionnees dans les regles du football australien.)
AU: Appleby,-B; Dawson,-B
SO: Journal-of-science-and-medicine-in-sport-(Belconnen,-A.C.T.) 5(2), June 2002, 129-142, Total No. of Pages: 14
PY: 2002
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; VIDEOTAPE-; VISUAL-FEEDBACK; MATCH-ANALYSIS; STATISTICS-; MARK-; RUCK-; KICKING-
SH: (542177) AUSTRALIAN-FOOTBALL STATISTICS-AND-RECORDS; (542045) AUSTRALIAN-FOOTBALL COACHING

AB: The frequency and outcome of common game activities during Australian football matches have not previously been reported. The aim of this investigation was to determine the frequency and outcome of marking opportunities (MO), ruck contests (RC) and kick-ins (KI), for the purpose of potentially refining current training methods to better replicate common game occurrences. Video footage of all 24 Australian Football League (AFL) matches in which the West Coast Eagles(WCE) participated during the 1997 premiership season was viewed. Notational analysis was used to record information for both the WCE and the opposition during MO, RC and KI. There was an average of 259 MO per game, of which 42.5% were unopposed by either team (1/0 or 0/1) and 45% involved one player from each team (1/1). The average success rate of unopposed marks (1/0 and 0/1) was 88.3%, opposed (1/1) 29.3% and, for all MO's combined, 53.5%. There was an average of 99 RC per game, of which 48 were bounce-downs (28 centre bounces) and 51 boundary throw-ins. The clearance rates from RC for WCE and the opposition were not associated with winning the match or each quarter (p>0.05, R=0.000), nor did the clearance rate correlate with other measures of game success (scoring shots, team quarter score, the difference in score between teams or the lead change each quarter). There was an average of 21 KI per game. For both teams combined, long kicks (over 50 metres) were the most preferred form of KI (49%) compared to medium (between 25 and 50 metres) (30%) and short (under 25 metres) (21%). Long kicks were the most ineffective at directly retaining possession (29.0%) whilst short kicks were the most effective (93.4%). Some practical (training) implications, based on these results, are discussed.
ITSH: (542177) FOOTBALL-AUSTRALIANO STATISTICA; (542045) FOOTBALL-AUSTRALIANO ALLENAMENTO
CL: RC1200 #2600
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-841024, https://secure.sportquest.com/su.cfm?articleno=S-841024&title=S-841024

TI: Analysis of selected game activities in Australian football - abstract

AU: Appleby,-B; Dawson,-B
CA: IOC-World-Congress-on-Sport-Sciences-5th-:-1999-:-Sydney,-Australia; Australian-Conference-of-Science-and-Medicine-in-Sport-1999-:-Sydney,
PB: In, Fifth IOC World Congress on Sport Sciences : book of abstracts, Canberra, Sports Medicine Australia, 1999, p.88
URL: http://www.ausport.gov.au/fulltext/1999/iocwc/abs088b.htm
PY: 1999
LE: Advanced
DE: MATCH-ANALYSIS; AUSTRALIAN-FOOTBALL; STATISTICS-
SH: (542310) AUSTRALIAN-FOOTBALL TESTING-AND-EVALUATION; (542045) AUSTRALIAN-FOOTBALL COACHING
ITSH: (542310) FOOTBALL-AUSTRALIANO TEST; (542045) FOOTBALL-AUSTRALIANO ALLENAMENTO

The frequency of common game activities during Australian football matches have not previously been reported. The purpose of this investigation was to determine the frequency and outcome of marking contests (MC), ruck contests (RC) and kick-ins from goal (KI). The aim of the study was to potentially refine current training methods to better replicate common game occurrences. Video footage of all 24 Australian Football League (AFL) matches in which the West Coast Eagles (WCE) participated in during the 1997 premiership season were viewed. Notational analysis was used to record information for both WCE and their opponents during MC, RC and KI. WCE player involvement was determined by recording jumper numbers and knowledge of team role. Descriptive statistics and logistic regressions were performed on the data. There was an average of 259 MC per game, of which 42.5% were unopposed by either team and 45.0% involved one player from each team. The average success rate of unopposed marks was 88.3%, opposed 29.3%, and for all MC's 53.5%. Spoiling during opposed contests accounted for 20.6% of unsuccessful marks. The average RC frequency per game was 99; 48 bounce-downs (28 centre bounces) and 51 boundary throw-ins. The average RC clearance rate for the WCE was 40%. The clearance rates from RC for WCE and the opposition were not associated with winning the game or each quarter (R=0.000). There were 11 team KI on average per game. For both teams (combined) long kicks (over 50 metres) were the most preferred form of KI (49%) compared to medium (between 25 and 50 metres) (30%) and short (under 25 metres) (21%). Long kicks were also the most ineffective at directly retaining possession (28.9%) whilst short kicks were the most effective (93.4%). First kick success (retaining possession) rates were WCE 61.9% and opposition 51.7%. It

was concluded that contested marks comprise a large percentage of all marking opportunities during a game and the skills of marking and spoiling (especially 1 on 1), should be practiced thoroughly to improve both offensive and defensive success during such contests. Further investigation is required in order to determine the effectiveness of various strategies of play from RC and KI.

TI: Delayed-onset muscle soreness does not alter the kinematics and kinetics of the squat-lifting technique

AU: Armstrong,-B-D; Cordova,-M-L; Ingersoll,-C-D; Lawrence,-N-F
SO: Journal-of-sport-rehabilitation-(Champaign,-Ill.) 10(3), Aug 2001, 184-195, Total No. of Pages: 12
PY: 2001
LE: Advanced
DE: DELAYED-ONSET-MUSCLE-SORENESS; KINEMATICS-; KINETICS-; BACK-; SQUAT-; TECHNIQUE-; YOUNG-ADULT; COMPARATIVE-STUDY
SH: (762027) WEIGHTLIFTING BIOMECHANICS; (762192) WEIGHTLIFTING TECHNIQUES-AND-SKILLS; (946400) BIOMECHANICS-KINEMATICS; (946450) BIOMECHANICS-KINETICS; (959850) INJURIES-AND-ACCIDENTS-MUSCLE-CRAMPS-AND-SORENESS

AB: Little research has been done evaluating the effects of muscle soreness on a lifting task. To examine the effects of delayed-onset muscle soreness (DOMS) in the thigh musculature on kinematic and kinetic variables associated with the squat-lifting technique. Pretest-posttest repeated measures, with treatment as the independent variable (DOMS and no DOMS of the thigh musculature). Setting: Research laboratory. Twenty healthy college students participated. Subjects were videotaped lifting a 157-N crate before and after DOMS inducement. A 2-dimensional sagittal-plane video analysis was used to calculate 7 kinematic and kinetic variables. DOMS had no effect on L5/S1 torque and shear or compression, hip torque and range of motion, or knee torque and range of motion during lifting. Conclusions: DOMS does not appear to alter kinematic and kinetic variables associated with the squat-lifting technique.

ITSH: (762027) SOLLEVAMENTO--PESI BIOMECANICA; (762192) SOLLEVAMENTO--PESI TECNICO; (946400) BIOMECCANICA-CINEMATICA; (946450) BIOMECCANICA-CINOSIOLOGIA; (959850) INFORTUNI-E-INCIDENTI-CRAMPO-MUSCOLARE/INDOLENZIMENT
CL: RC1200 #2060
SX: This document is available via SIRCExpress Order Number S-789594, https://secure.sportquest.com/su.cfm?articleno=S-789594&title=S-789594

TI: Descriptional analysis of a woman's tennis tournament data. (Abstract)

AU: Athanailidis,-I; Zarotis,-G; Mitrotasios,-M; Mauromatis,-G
PB: In Koskolou, M. (ed.), European College of Sport Science, Proceedings of the 7th annual congress of the European College of Sport Science, Athens, Greece, 24-28 July 2002, Athens, Pashalidis Medical Publisher, c2002, p.495, Total No. of Pages: 1
CN: European College of Sport Science. Congress (7th : 2002 : Athens).
PY: 2002
LE: Advanced
DE: TENNIS-; WOMAN-; TOURNAMENT-; COACHING-; FEEDBACK-; PATTERN-; MATCH-ANALYSIS; STATISTICS-; WORLD-MASTERS-CHAMPIONSHIPS; 2001-; OCCURRENCE-; SERVE-; SCORING-; CORRELATION-
SH: (708310) TENNIS TESTING-AND-EVALUATION; (708283) TENNIS TECHNIQUES-AND-SKILLS-SERVING; (708398) TENNIS WOMEN
ITSH: (708310) TENNIS TEST; (708283) TENNIS TECNICO-SERVIZIO; (708398) TENNIS DONNE
CL: GV 557.5 #35611
SX: This document is available via SIRCExpress Order Number S-866657, https://secure.sportquest.com/su.cfm?articleno=S-866657&title=S-866657

TI: Sepaktakraw: Heart rate and blood lactate response and physiological profile of elite players - abstract

AU: Aziz,-R; Tan,-B-C; Teh,-K-C
CA: IOC-World-Congress-on-Sport-Sciences-5th-:-1999-:-Sydney,-Australia; Australian-Conference-of-Science-and-Medicine-in-Sport-1999-:-Sydney,
PB: In, Fifth IOC World Congress on Sport Sciences : book of abstracts, Canberra, Sports Medicine Australia, 1999, p.115
URL: http://www.ausport.gov.au/fulltext/1999/iocwc/abs115b.htm
PY: 1999
LE: Advanced
DE: SEPAK-TAKRAW; ELITE-ATHLETE; PHYSIOLOGY-; LACTATE-; HEART-RATE; MATCH-ANALYSIS
SH: (540127) TEAM-SPORTS PHYSIOLOGY
ITSH: (540127) SPORT-DI-SQUADRA FISIOLOGIA

TI: Assessing player performance in tennis match play by compute-aided game analysis. (Abstract)

AU: Baca,-A; Schmidt,-M
PB: In Koskolou, M. (ed.), European College of Sport Science, Proceedings of the 7th annual congress of the European College of Sport Science, Athens, Greece, 24-28 July 2002, Athens, Pashalidis Medical Publisher, c2002, p.309, Total No. of Pages: 1
CN: European College of Sport Science. Congress (7th : 2002 : Athens).
PY: 2002
LE: Advanced
DE: TENNIS-; COMPUTER-; SKILL-; ACHIEVEMENT-; STROKE-; MOVEMENT-; MATCH-ANALYSIS; HEART-RATE; PULMONARY-GAS-EXCHANGE; LACTATE-; VIDEOTAPING-; TRAINING-LOAD; THEORETICAL-MODEL
SH: (708305) TENNIS TECHNOLOGY - COMPUTER-APPLICATIONS; (946700) BIOMECHANICS-SKILLS-ANALYSIS; (946870) BIOMECHANICS-TECHNIQUE-COMPUTER-ANALYSIS
ITSH: (708305) TENNIS TECNOLOGIA - APPLICAZIONI-INFORMATICHE; (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (946870) BIOMECCANICA-ANALISI-COMPUTERIZZATA
CL: GV 557.5 #35611
SX: This document is available via SIRCExpress Order Number S-866419, https://secure.sportquest.com/su.cfm?articleno=S-866419&title=S-866419

TI: Effectiveness of serves used during 12th Feminine African Volleyball Clubs Championship

AU: Bailasha,-N; Akpata,-D
SO: Journal-of-the-International-Council-for-Health,-Physical-Education,-Recreation,-Sport,-and-Dance-(Reston,-Va.) 38(1), Winter 2002, 46-49, Total No. of Pages: 4
PY: 2002
LE: Advanced
DE: VOLLEYBALL-; STRATEGY-; SERVE-; MATCH-ANALYSIS; EVALUATION-STUDY; WOMAN-; AFRICA-
SH: (588180) VOLLEYBALL STRATEGY; (588398) VOLLEYBALL WOMEN
AB: This study investigated technical and tactical paradigms in volleyball to determine levels of African volleyball players masteries of serves, and how they used them tactically, to determine outcomes of games. Nineteen matches were recorded for analyses during the 12th African Feminine Clubs Championship. A modified form of a volleyball analysis instrument, developed by the United States Volleyball Association, was used to collect data. Chi square was employed to determine relationships among types of serves, and establish relationships of effectiveness for each type of

serve. Findings showed the floater was the most used, and most effective serve. Teams did not diversify types of serves, thereby making attacks ab initio.
ITSH: (588180) PALLAVOLO TATTICA; (588398) PALLAVOLO DONNE
CL: GV201 #4481
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-804690, https://secure.sportquest.com/su.cfm?articleno=S-804690&title=S-804690

Record 17 of 281 - SPORT Discus

TI: The use of video analysis for mediational learning (old way/new way): new technology meets a new approach to skill correction and maintenance in elite sport - abstract

AU: Baker,-K; Bannon,-S; Rawlins,-T
CA: Australian-Conference-of-Science-and-Medicine-in-Sport-2001-:-Perth,; Sports-Medicine-Australia
PB: In Sports Medicine Australia, 2001: a sports medicine odyssey: challenges, controversies and change: Australian Conference of Science and Medicine in Sport 23-27 October 2001, Perth, WA, Dickson, A.C.T., Sports Medicine Australia, c2001, p.121, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2001/acsms/papers/BAKE2.pdf
CN: Australian Conference of Science and Medicine in Sport (2001 : Perth, Western Australia)
PY: 2001
LE: Advanced
DE: COACHING-; LEARNING-; SKILL-; TECHNIQUE-; CASE-STUDY; ELITE-ATHLETE; SOUTH-AUSTRALIAN-SPORTS-INSTITUTE; VIDEOTAPE-; EVALUATION-
SH: (902640) COACHING-TEACHING-METHODS
ITSH: (902640) ALLENAMENTO-METODI-D'ALLENAMENTO

Record 18 of 281 - SPORT Discus

TI: Optimal use of tennis resources

AU: Barnett,-T; Brown,-A; Clarke,-S-R
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.57-65, Total No. of Pages: 9
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: TENNIS-; STRATEGY-; MATCH-ANALYSIS; MATHEMATICAL-MODEL; STATISTICS-; ENERGY-EXPENDITURE; ANALYSIS-OF-VARIANCE
SH: (708180) TENNIS STRATEGY
AB: This paper demonstrates how tennis players can optimize their chance of winning a match by using strategies to utilize their energy resources. This can be achieved by either increasing their effort on certain points, games and sets in a match, or by increasing and decreasing effort about an overall mean. The results show that increasing effort on any point before deuce is reached has the same effect on the player's chances of winning the game. By increasing effort on the important points and decreasing effort on the unimportant points in a game, players can increase their chances of winning a game. For the better player, this gain is a result of variability about the mean and also the importance of points. The results obtained in tennis are used to investigate problems related to warfare.
ITSH: (708180) TENNIS TATTICA

Record 19 of 281 - SPORT Discus

TI: Predicting women's World Cup handball match outcomes using optimised ratings models

AU: Bedford,-A

PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.66-74, Total No. of Pages: 9
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: TEAM-HANDBALL; WOMAN-; MATCH-ANALYSIS; MATHEMATICAL-MODEL; PERFORMANCE-PREDICTION; RANKING-
SH: (584110) TEAM-HANDBALL MATHEMATICS

AB: This paper examines three differing ratings models in order to determine final rankings and round-based predictions for women's handball. The 2001 World Cup results were used to optimise the three models post tournament. This involved maximising the percentage of correctly predicted matches, then minimising the error whilst varying each model's weighting constant. These models were then used to predict match results for the 2003 World Cup. A modified Elo model, a smoothing model and a Pythagorean Projection model were analyzed. All three returned high success rates in 2001 and proved useful in determining the tournament outcome in 2003.
ITSH: (584110) PALLAMANO-DI-SQUADRA MATEMATICA

Record 20 of 281 - SPORT Discus

TI: Biomechanical analysis of the pole vault in national collegiate competition

AU: Bergemann,-B
SO: Acta-Kinesiologiae-Universitatis-Tartuensis-(Tartu) 82003, 14-33, Total No. of Pages: 20
PY: 2003
LE: Advanced
DE: BIOMECHANICS-; KINEMATICS-; POLE-VAULT; TECHNIQUE-; UNIVERSITY-; NATIONAL-CHAMPIONSHIP
SH: (720027) POLE-VAULT BIOMECHANICS; (720192) POLE-VAULT TECHNIQUES-AND-SKILLS

AB: The following is a study of the NCAA pole vault competition that took place in 2000 at Duke University in Durham, NC. There were 9 vaulters and 19 successful vaults analyzed ranging from 5.15 to 5.6 m. A two-dimensional video analysis at 60 Hz was performed and many linear and angular kinematic parameters were measured. The Ariel Performance Analysis System was used to process the video data. The pole vaulters were consistently "under" at the pole plant by 0.45 m and still "under" at the take-off by 0.16 m. The horizontal velocity showed a decrease from 9.8 m/s between the 3rd and 2nd last steps, to 9.44 m/s between the 2nd and last steps, to 8.6 m/s at pole plant, and to 7.6 m/s at take-off. Some energy transformations from horizontal kinetic energy to strain energy in the pole were already occurring prior to the time of take-off. The maximum pole bend was measured as the minimum distance from the top hand to the bottom of the box and was 3.32 m. The extension of the body followed by the turn and push were less than optimal due to the straightening effect of the pole and the shallow angle of the projection of the CG from the pole at pole release. This study provides current data on collegiate class vaulters that coaches and researchers can use for comparative and new research purposes.
ITSH: (720027) SALTO-CON-L ' ASTA BIOMECANICA; (720192) SALTO-CON-L ' ASTA TECNICO
CL: QP302 P4 #260
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-930088, https://secure.sportquest.com/su.cfm?articleno=S-930088&title=S-930088

Record 21 of 281 - SPORT Discus

TI: W poszukiwaniu wyznacznikow skutecznosci gry w pilke nozna Searching for determinants of playing effectiveness in soccer

AU: Bergier,-J
SO: Wychowanie-fizyczne-i-sport-(Warsaw) 42(2), 1998, 81-91, Total No. of Pages: 11
PY: 1998
LE: Intermediate
DE: SOCCER-; WORLD-CHAMPIONSHIP; 1994-; EUROPEAN-CHAMPIONSHIP; 1988-; JUNIOR-CHAMPIONSHIP; 1990-; COMPETITION-; ACHIEVEMENT-; STRATEGY-; TECHNIQUE-; MATCH-ANALYSIS; EVALUATION-STUDY; ELITE-ATHLETE
SH: (576174) SOCCER SPORTING-EVENTS; (576192) SOCCER TECHNIQUES-AND-SKILLS

AB: The effectiveness of technical and tactical activities are of particular importance while examining the course of competition in soccer. Observations of top-ranking soccer events of recent years: the 1990 and 1994 World Championships, the 1988 European Championships and the 1990 Junior European Championships were made use of. An analysis of these championships allowed model indicators of playing effectiveness to be established, which condition success in soccer matches.

ITSH: (576174) CALCIO COMPETIZIONE-SPORTIVA; (576192) CALCIO TECNICO

CL: GV201 #4340

SX: This document is available via SIRCExpress Order Number S-668783, https://secure.sportquest.com/su.cfm?articleno=S-668783&title=S-668783

Record 22 of 281 - SPORT Discus

TI: ACL injuries resulting from exiting ski lifts: a video analysis. (Abstract)

AU: Binet,-M-H; Bally,-A; Laporte,-J

SO: Knee-surgery,-sports-traumatology,-arthroscopy-(Berlin) 10(6), Nov 2002, 386, Total No. of Pages: 1

CN: Symposium on Ski Trauma and Skiing Safety (14th : 2001)

PY: 2001

LE: Intermediate

DE: EPIDEMIOLOGY-; OCCURRENCE-; ETIOLOGY-; ANTERIOR-CRUCIATE-LIGAMENT; INJURY-; SKIING-; CHAIR-LIFT; FRANCE-

SH: (504093) SKIING INJURIES-AND-ACCIDENTS

AB: This study investigated video documentation of knee sprains occurring as skiers exited a chairlift. The study was carried out during the 1999/2000 and 2000/2001 ski seasons in France.

ITSH: (504093) SCI INFORTUNI-E-INCIDENTI

CL: RD97 P4 #60

SX: This document is available via SIRCExpress Order Number S-864107, https://secure.sportquest.com/su.cfm?articleno=S-864107&title=S-864107

Record 23 of 281 - SPORT Discus

TI: Physiological responses to 90 min of simulated dinghy sailing

AU: Blackburn,-M

SO: Journal-of-sports-sciences-(London) 12(4), Aug 1994, 383-390, Total No. of Pages: 8

PY: 1994

LE: Advanced

DE: YACHTING-; ISOMETRIC-; PHYSIOLOGY-; ADAPTATION-; SIMULATION-; COMPARATIVE-STUDY; ADOLESCENT-; YOUNG-ADULT; HEART-RATE; BLOOD-PRESSURE; HIKING-

SH: (454127) YACHTING PHYSIOLOGY; (472127) BACKPACKING-AND-HIKIN PHYSIOLOGY

AB: A dinghy sailing race protocol was developed from video analysis of elite Laser class sailors competing in fairly windy (greater than 12 knots) national level races. A dinghy sailing ergometer was constructed for use with a 90 min protocol. Subjects watched a video of a Laser dinghy skipper sailing (on-water) according to the protocol while themselves hiking (leaning out) from the ergometer and simulating their normal on-water movements in tandem with the video. This simulation was used a examine physiological responses to dinghy sailing and factors correlated with hiking performance in 10 of Australia's top 30 Laser dinghy sailors. Simulated dinghy sailing elicited a large blood pressure response but a low rate of aerobic and anaerobic metabolism. During the 20 min upwind legs, the mean (plus/minus S.E.M.) systolic and diastolic blood pressures were 172 plus/minus 18 and 100 plus/minus 14 mmHg respectively, and mean arterial blood pressure (MABP) was 123 plus/minus 14 mmHg. Oxygen uptake during the simulated upwind legs was 2.32 plus/minus 0.81 mM. Isometric knee extension strength (at 130 degrees) and the length to which subjects set the hiking strap on the ergometer were moderately related to upwind hiking performance (knee extension strength and upwind hiking strap tension, r=0.62; hiking strap length and upwind righting moment, r=0.66; both P less than 0.05). Thus, a number of factors, including strength, hiking strap length and cardiovascular fitness, apparently determined righting moment and hiking strap tension during Laser sailing. It is suggested that it is only the discontinuous nature of hiking which allows dinghy sailors to sustain the isometric contractions for extended periods.

ITSH: (454127) VELA FISIOLOGIA; (472127) BACKPACKING FISIOLOGIA

CL: RC1200 #700

TI: Differences in badminton performance between winning and losing players. (Abstract)

AU: Blomqvist,-M; Luhtanen,-P; Laakso,-L
PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.490, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs490a.htm
CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)
PY: 2000
LE: Advanced
DE: BADMINTON-; MATCH-ANALYSIS; WINNING-; LOSING-; COMPARATIVE-STUDY; KNOWLEDGE-LEVEL; SKILL-
SH: (690147) BADMINTON PSYCHOLOGY
ITSH: (690147) BADMINTON PSICOLOGIA

The purpose of this study was to describe the differences in knowledge, game understanding, skill and game performance between winning and losing players in badminton. Physical education students (N=21) served as subjects and each student participated first into two types of cognitive tests: a paper-pencil knowledge test which contained 39 questions of badminton terminology, rules and scoring, technique and strategy and a video-based game understanding test which included 15 different offensive and defensive simulated badminton situations. In addition students participated in a skill test which included three different shots (serve, clear and drop) and played 15-min singles badminton against an opponent of similar abilities. All the matches were video recorded and analyzed afterwards using SAGE Game Manager for Badminton software. Although no significant differences between the groups were found in the knowledge, game understanding and skill tests scores a trend favoring the winning players was found in all these variables. The only significant differences between winning and losing players were found in the game analysis variables as follows: successful shots (89.9± 3.4; 83.0± 5.0, p<.001), forceful shots (48.5± 14.9; 43.3± 30.1, p<.01), forced errors (5.9± 2.9; 8.1± 2.6, p<.05), unforced errors (4.3± 1.7; 9.0± 4.0, p<.001) and cooperative shots (16.3± 6.8; 26.6± 9.7, p<.001). Based on the results of the game analysis and the relationships between the measured variables it could be said that winning players played a more effective and competitive game when compared to losing players and that in both groups player's knowledge base seemed to be the dominant factor related to all the other measured qualities.

TI: Expert-novice differences in game performance and game understanding of youth badminton players

AU: Blomqvist,-M; Luhtanen,-P; Laakso,-L
SO: European-journal-of-physical-education-(West-Malling,-England) 5(2), 2000, 208-219, Total No. of Pages: 12
PY: 2000
LE: Advanced
DE: BADMINTON-; ADOLESCENT-; NOVICE-ATHLETE; ATHLETE-; TESTING-; CLEAR-; DROP-SHOT; SERVE-; ACHIEVEMENT-; SKILL-; MATCH-ANALYSIS
SH: (690192) BADMINTON TECHNIQUES-AND-SKILLS; (690310) BADMINTON TESTING-AND-EVALUATION
AB: The purpose of this investigation was to examine differences in skill, game performance and game understanding in expert (n = 12) and novice (n = 14) youth badminton players (13-14 years). Each subject participated in skill tests (serve, clear and drop) and a game understanding test which consisted of 15 different video simulations of actual offensive and defensive game situations. In every sequence, players were to solve tactical problems by selecting appropriate solutions and arguments for their decisions. In addition they played 2 x 10-min singles badminton. All

matches were video recorded and post match analysed. Results clearly showed that skill, game play and cognitive components all differentiated experts from novices. Experts exhibited significantly more sport skill, played more effective shots and understood the game situations better when compared to novices. Based on the findings it could be suggested that all these qualities must be taken into account when teaching/coaching games in order to increase competence, interest and enjoyment in games playing.

ITSH: (690192) BADMINTON TECNICO; (690310) BADMINTON TEST
CL: GV201 #5380
SX: This document is available via SIRCExpress Order Number S-667602, https://secure.sportquest.com/su.cfm?articleno=S-667602&title=S-667602

Record 26 of 281 - SPORT Discus

TI: Validation of a notational analysis system in badminton (Validation d' un systeme informatise d' analyse de match de badminton)

AU: BLOMQVIST-M; LUHTANEN-P; LAAKSO-L
SO: Journal of human movement studies ROYAUME UNI 1998, t 35, n 3, pp 137-150, 14p 13 ref
PY: 1998
LE: Advanced

Record 27 of 281 - SPORT Discus

TI: Biomechanische Ergebnisse zur Bewegungstechnik im Gewichtheben (Reissen)
(Resultats biomecaniques dans la technique cinetique chez les halterophiles.)

Biomechanical results about the movement technique in weightlifting

AU: Boettcher,-J; Deutscher,-E
SO: Leistungssport-(Muenster) 29(4), July 1999, 55-62, Total No. of Pages: 8
PY: 1999
LE: Advanced
DE: WEIGHTLIFTING-; KINEMATICS-; SNATCH-; MAN-; WOMAN-; TECHNIQUE-
SH: (762027) WEIGHTLIFTING BIOMECHANICS; (946400) BIOMECHANICS-KINEMATICS
AB: In recent biomechanical investigations of weightlifting the relationship between competition performance and movement technique was almost ignored. In this article kinematic aspects of the movement technique of the snatch is analysed, and performance-determining parameters of training control are presented. Using a three-dimensional video-picture analysis of German and international top-level athletes from all weight classes important movement phases of the snatch are standardised on the basis of theoretical reflections.

ITSH: (762027) SOLLEVAMENTO--PESI BIOMECANICA; (946400) BIOMECCANICA-CINEMATICA
CL: GV701.P4 #420
SX: This document is available via SIRCExpress Order Number S-79577, https://secure.sportquest.com/su.cfm?articleno=S-79577&title=S-79577

Record 28 of 281 - SPORT Discus

TI: Temporal pattern analysis and its applicability in sport: an explanation and exemplar data

(L' analyse des parametres temporels et son application en sport: une explication et des donnees d' exemple.)
AU: Borrie,-A; Jonsson,-G-K; Magnusson,-M-S
SO: Journal-of-sports-sciences-(London) 20(10), Oct 2002, 845-852, Total No. of Pages: 8
PY: 2002
LE: Advanced
DE: SOCCER-; COACHING-; MATCH-ANALYSIS; SKILL-; STRATEGY-
SH: (576045) SOCCER COACHING; (576118) SOCCER PERCEPTUAL-MOTOR-PROCESSES

AB: Quantitative analysis of sports performance has been shown to produce information that coaches can use within the coaching process to enhance performance. Traditional methods for quantifying sport performances are limited in their capacity to describe the complex interactions of events that occur within a performance over time. In this paper, we outline a new approach to the analysis of time-based event records and real-time behavior records on sport performance known as T-pattern detection. The relevant elements of the T-pattern detection process are explained and exemplar data from the analysis of 13 soccer matches are presented to highlight the potential of this form of analysis. The results from soccer suggest that it is possible to identify new profiles for both individuals and teams based on the analysis of temporal behavioral patterns detected within the performances.
ITSH: (576045) CALCIO ALLENAMENTO; (576118) CALCIO ABILITA-MOTORIA
CL: RC1200 #700
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-847013, https://secure.sportquest.com/su.cfm?articleno=S-847013&title=S-847013

Record 29 of 281 - SPORT Discus

TI: Extraction, interpretation and utilisation of meaningful information about individual rugby performances using data mining

AU: Bracewell,-P-J
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.88-99, Total No. of Pages: 12
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: RUGBY-UNION; MATCH-ANALYSIS; MATHEMATICAL-MODEL; EVALUATION-
SH: (574110) RUGBY-UNION MATHEMATICS; (574305) RUGBY-UNION TECHNOLOGY - COMPUTER-APPLICATIONS
AB: Statistics are having an increased influence in the rugby-coaching environment. Many of the statistics used are exposed to changeable match constraints and conditions, reducing the practical significance of this data. Assuming that the events occurring on the rugby field are largely due to the manifestation of individual ability; then the mining of match data provides insight into individual performance. The importance of understanding the data is emphasised, placing the extraction of performance ratings in context. Consequently data mining techniques allow useful statistics to be extracted from match data. These summarise individual performance and negate the variability in match involvement. Standard data mining techniques are used to construct a stable measure of overall performance, providing the coach or domain expert with a simplified data set that can be explored using graphical techniques, such as control charts, to guide decision-making. This increases the power of the statistical tool available to coaches by enabling deficient or superior performances to be identified.
ITSH: (574110) RUGBY-UNION MATEMATICA; (574305) RUGBY-UNION TECNOLOGIA - APPLICAZIONI-INFORMATICHE

Record 30 of 281 - SPORT Discus

TI: 6 Campeonato do Mundo de Juniores Masculinos de Basquetebol: a analise do sucesso realizada a partir das estatisticas do jogo

    (6th Junior Male World Championship in Basketball: an analysis of achievements based on game statistics.)
AU: Brandao,-E; Janeira,-M; Sampaio,-J
SO: Lecturas:-educacion-fisica-y-deportes-(Buenos-Aires) 8(45), Feb 2002
URL: http://www.efdeportes.com/efd45/basquete.htm
PY: 2002
LE: Advanced
DE: BASKETBALL-; WORLD-CHAMPIONSHIP; ACHIEVEMENT-; STATISTICS-; MATCH-ANALYSIS
SH: (546174) BASKETBALL SPORTING-EVENTS; (546177) BASKETBALL STATISTICS-AND-RECORDS
AB: The purpose of this study was to identify the differences in team play between winning and losing teams during the sixth Junior Male World Championship in Basketball (1999).

TI: *Modelling the flight of a soccer ball in a direct free kick*

(Modelisation de la trajectoire d' un ballon de football lors d' un coup franc direct.)
AU: Bray,-K; Kerwin,-D-G
SO: Journal-of-sports-sciences-(London) 21(2), Feb 2003, 75-85, Total No. of Pages: 11
PY: 2003
LE: Advanced
DE: SOCCER-; AERODYNAMICS-; DRAG-; BALL-; FREE-KICK; MATHEMATICAL-MODEL; EXPERIMENTATION-
SH: (576005) SOCCER AERODYNAMICS; (576257) SOCCER TECHNIQUES-AND-SKILLS-KICKING

AB: This study involved a theoretical and an experimental investigation of the direct free kick in soccer. Our aim was to develop a mathematical model of the ball's flight incorporating aerodynamic lift and drag forces to explore this important 'set-play'. Trajectories derived from the model have been compared with those obtained from detailed video analysis of experimental kicks. Representative values for the drag and lift coefficients have been obtained, together with the implied orientation of the ball's spin axis in flight. The drag coefficient varied from 0.25 to 0.30 and the lift coefficient from 0.23 to 0.29. These values, used with a simple model of a defensive wall, have enabled free kicks to be simulated under realistic conditions, typical of match-play. The results reveal how carefully attackers must engineer the dynamics of a successful kick. For a central free kick some 18.3 m (20 yards) from goal with a conventional wall, and initial speed of 25 m.s-1, the ball's initial elevation must be constrained between 16.5 degrees and 17.5 degrees and the ball kicked with almost perfect sidespin.
ITSH: (576005) CALCIO AERODINAMICA; (576257) CALCIO TECNICO-CALCIARE
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-864773, https://secure.sportquest.com/su.cfm?articleno=S-864773&title=S-864773

TI: *The predictive value of variables for the evaluation of technical-tactical elements in handball*

(Praediktabler Variablenwert zur Abschaetzung von technisch-taktischen Spielelementen des Handballspiels.)
AU: Brcic,-B; Viskic-Stalec,-N; Fressl,-Z-J
SO: Kinesiology-(Zagreb) 29(1), June 1997, 60-70, Total No. of Pages: 11
PY: 1997
LE: Advanced
DE: TEAM-HANDBALL; WOMAN-; ACHIEVEMENT-; ELITE-ATHLETE; CROATIA-; STRATEGY-; MATCH-ANALYSIS; TECHNIQUE-; EVALUATION-
SH: (584192) TEAM-HANDBALL TECHNIQUES-AND-SKILLS; (584180) TEAM-HANDBALL STRATEGY

AB: The predictive value of the set of 43 variables, designed for the evaluation of handball technical-tactical elements, was tested on a sample of 91 handball matches of the Croatian Championship 1st League for women of the 1995/96 competition season. Twelve teams were categorized in three qualitative groups according to the final rank at the end of the season. The basic parameters of the variables within each qualitative group of teams were determined, as well as the parameters for the entire sample of teams. A three-way factor analysis of variance (MANOVA) was applied in order to determine the predictive power of the game indicators to discriminate between the teams according to the following criteria: the team's pertaining to different qualitative groups, the opposing team's membership to different qualitative groups and the play of domestic/visiting teams. It was established that the constructed battery of 43 variables successfully discriminated between matches of the teams pertaining to different qualitative categories of the teams, matches of the opposing teams pertaining to different qualitative categories of the opponents, and matches played at home and away. However, the differences in play among the teams of different qualitative categories and the opposing teams of different qualitative categories were not established. No difference in play was found among teams of different qualitative categories when playing matches at home or away, neither were the differences proved among the opposing teams differently categorized when playing at home or away. No interaction among all three classification variables were established.
ITSH: (584192) PALLAMANO-DI-SQUADRA TECNICO; (584180) PALLAMANO-DI-SQUADRA TATTICA
SX: This document is available via SIRCExpress Order Number 421199, https://secure.sportquest.com/su.cfm?articleno=421199&title=421199

TI: Prediktivna vrijednost varijabli za procjenu tehnicko-taktickih elemenata rukometne igre

The predictive value of variables for the evaluation of technical-tactical elements in handball

AU: Brcic,-B; Viskic-Stalec,-N; Jaklinovic-Fressl,-Z
SO: Kineziologija-(Zagreb) 29(1), June 1997, 55-64, Total No. of Pages: 10
PY: 1997
LE: Advanced
DE: TEAM-HANDBALL; WOMAN-; ACHIEVEMENT-; ELITE-ATHLETE; CROATIA-; STRATEGY-; MATCH-ANALYSIS; TECHNIQUE-; EVALUATION-
SH: (584180) TEAM-HANDBALL STRATEGY; (584192) TEAM-HANDBALL TECHNIQUES-AND-SKILLS

AB: The predictive value of the set of 43 variables, designed for the evaluation of handball technical-tactical elements, was tested on a sample of 91 handball matches of the Croatian Championship 1st League for women of the 1995/96 competition season. Twelve teams were categorized in three qualitative groups according to the final rank at the end of the season. The basic parameters of the variables within each qualitative group of teams were determined, as well as the parameters for the entire sample of teams. A three-way factor analysis of variance (MANOVA) was applied in order to determine the predictive power of the game indicators to discriminate between the teams according to the following criteria: the team's pertaining to different qualitative groups, the opposing team's membership to different qualitative groups and the play of domestic/visiting teams. It was established that the constructed battery of 43 variables successfully discriminated between matches of the teams pertaining to different qualitative categories of the teams, matches of the opposing teams pertaining to different qualitative categories of the opponents, and matches played at home and away. However, the differences in play among the teams of different qualitative categories and the opposing teams of different qualitative categories were not established. No difference in play was found among teams of different qualitative categories when playing matches at home or away, neither were the differences proved among the opposing teams differently categorized when playing at home or away. No interaction among all three classification variables were established.
ITSH: (584180) PALLAMANO-DI-SQUADRA TATTICA; (584192) PALLAMANO-DI-SQUADRA TECNICO
SX: This document is available via SIRCExpress Order Number S-19827, https://secure.sportquest.com/su.cfm?articleno=S-19827&title=S-19827

TI: Leg strength and stiffness as ability factors in 100 m sprint running (Etude de la force et de la raideur de la jambe lors d' une course de vitesse sur 100m.)

AU: Bret,-C; Rahmani,-A; Dufour,-A-B; Messonnier,-L; Lacour,-J-R
SO: Journal-of-sports-medicine-and-physical-fitness-(Torino) 42(3), Sept 2002, 274-281, Total No. of Pages: 8
PY: 2002
LE: Advanced
DE: LEG-; STRENGTH-; ELASTICITY-; FLEXIBILITY-; SPRINTING-; ACHIEVEMENT-; SKILL-; SPEED-; JUMPING-; HOPPING-; TESTING-; MEASUREMENT-; MAN-; ATHLETE-; VIDEOTAPING-; REGRESSION-ANALYSIS
SH: (740310) SPRINTING TESTING-AND-EVALUATION; (740127) SPRINTING PHYSIOLOGY; (977400) PHYSICAL-FITNESS-TESTING-STRENGTH-TESTING

AB: The purpose of this study was to determine the importance of leg strength and stiffness relative to i) 100 m sprint performance, ii) mean speed on the three phases of the 100 m race (30-60-100 m) and iii) the speed differences between these phases. Nineteen regional to national level male sprinters competed in a 100 m race. Video analysis was used to determine mean velocity parameters. Two subgroups were created since some of the runners decreased their velocity during the third phase (G1), whereas others maintained or accelerated it (G2). Leg strength (concentric half-squats - counter movement jump) and stiffness (hopping) were determined. Simple (r) and multiple regressions (R) were used. The mean performance over 100 m was 11.43 sec (10.72-12.87 sec). The concentric half-squats were related to 100 m ($r = 0.74$, $p < 0.001$) and to the mean speed of each phase ($R = 0.75$, $p < 0.01$). The counter movement jump was

related to 100 m (r = 0.57, p < 0.05) and was the predictor of the first phase (r = 0.66, p < 0.01). The hopping test was the predictor of the two last phases (R = 0.66, p < 0.05). Athletes who had the greatest leg stiffness (G1) produced the highest acceleration between the first and the second phases, and presented a deceleration between the second and the third ones. The concentric half-squats test was the best predictor in the 100 m sprint. Leg stiffness plays a major role in the second phase.

ITSH: (740310) CORSA-CORSE-DI-VELOCITA TEST; (740127) CORSA-CORSE-DI-VELOCITA FISIOLOGIA; (977400) CONDIZIONE-FISICA-TEST-TEST-DI-FORZA

CL: RC1200 #680

SX: This document is available via SIRCExpress Order Number S-845120, https://secure.sportquest.com/su.cfm?articleno=S-845120&title=S-845120

Record 35 of 281 - SPORT Discus

TI: Comparison of the incidences of selected events performed by youth players in regulation and modified soccer games

AU: Brown,-E-W; Wisner,-D-M; Kontos,-A

SO: IJASS:-International-journal-of-applied-sport-sciences-(Seoul,-Korea) 122000, 2-21, Total No. of Pages: 20

PY: 2000

LE: Advanced

DE: SOCCER-; MODIFICATION-; VIDEOTAPING-; RULE-; TIME-; TURF-; MEASUREMENT-; CHILD-; AGE-FACTOR; SEX-FACTOR; MATCH-ANALYSIS; MULTIVARIATE-ANALYSIS

SH: (576350) SOCCER VARIATIONS; (576033) SOCCER CHILDREN

AB: Videotape data were collected on youth soccer games played under two conditions: 11 players per side on a regulation field and 7 players per side on a smaller field. Multivariate analysis of variance (MANOVA) was used to analyze selected incidences of events per ten minutes of game time per field player. Comparisons were made between the two field/player combinations, between boys and girls, and between second-grade and fourth-grade players. Significant differences were found between regulation and modified play (F(3,16) = 47.93, p = 0.004), with nearly all measures for modified play being significantly greater, suggesting that modified play offers greater exposure to game events and thus greater opportunity for learning and skill development. No significant differences were found between boys and girls (F(3,16) = 4.86, p = 0.109). Significant differences were found between second-grade and fourth-grade players (F(3,16) = 60.49, p = 0.003), mostly favoring older players. The amount of time the ball remained in play was also analyzed. Under both field/player combinations the ball remained in play less than 60 percent of the total game time.

ITSH: (576350) CALCIO VARIAZIONE; (576033) CALCIO BAMBINI

CL: GV701.P4 #1361

SX: This document is available via SIRCExpress Order Number S-869933, https://secure.sportquest.com/su.cfm?articleno=S-869933&title=S-869933

Record 36 of 281 - SPORT Discus

TI: Using performance or results to measure the quality of sports competitors

AU: Cameron,-M

PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.100-112, Total No. of Pages: 13

CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)

PY: 2004

LE: Advanced

DE: RUGBY-UNION; MATCH-ANALYSIS; MATHEMATICAL-MODEL; PERFORMANCE-PREDICTION; RANKING-

SH: (574110) RUGBY-UNION MATHEMATICS; (574305) RUGBY-UNION TECHNOLOGY - COMPUTER-APPLICATIONS

AB: This paper examines the theoretical framework that underlies performance-based sports ranking systems. A basic model of competitor quality is developed with special attention given to assumptions necessary to create the reduced-form performance model which is used by most sports ratings systems. The key assumptions that underlie the reduced form model include optimality of team selection, and optimality of strategy selection. The paper then tests a simple linear dynamic model applied to Super 12 rugby. The model performs adequately, accurately predicting nearly 64% of results from the 2003 season and over 70% of late-season results. The incorrect predictions of late-season games illustrate that

not only are the predictions not sensitive to deviations from optimality in strategy or team selection in the current trial, but the ratings themselves are likely to be biased (in unknown directions and of unknown magnitudes) due to deviations from optimality in previous trials. Future developments in this theory should focus on measurement of the factors that impact on player skills and elements of successful team selection and strategy, as well as further development of the theory surrounding risk preference, utility of performance and discounting.
ITSH: (574110) RUGBY-UNION MATEMATICA; (574305) RUGBY-UNION TECNOLOGIA - APPLICAZIONI-INFORMATICHE

TI: Localisation de points critiques lors du tirage a l' arrache en halterophilie   (The snatch lift in weightlifting by identification of critical points.)

AU: Campillo,-P; Chollet,-D; Micallef,-J-P
SO: Science-and-sports-(Paris) 13(2), mars/avril 1998, 90-92, Total No. of Pages: 3
PY: 1998
LE: Advanced
DE: WEIGHTLIFTING-; ELITE-ATHLETE; BIOMECHANICS-; SNATCH-; STRENGTH-; SPEED-; YOUNG-ADULT; MAN-
SH: (762027) WEIGHTLIFTING BIOMECHANICS; (946700) BIOMECHANICS-SKILLS-ANALYSIS

AB: The aim of this study was to analyze the snatch lift techniques used by six international weightlifters. The variations in vertical force Fz(t) were examined using loads of 70 percent, 80 percent and 90 percent of their maximum performance. With a force platform and 2-D video analysis system the different critical points on these pull-snatch curves Fz(t) can be identified: two maximums (Tz1, Fz1) and (Tz3, FZ3), separated by a minimum (Tz2, Fz2). These technical phases were translated kinetically and dynamically from the technical phase transitions. The high correlations (r greater than 0.80, P less than 0.05) of the critical points (Tz1, Fz1; Tz2, Fz2; Tz3, Tz3, Fz3), and its effect on the kinetic variables of the bar should be noted. The reduction in the force ratio Fz1/Fz2, and the increase in Fz3/Fz1 give an indication of the technical potential of the weightlifter.
ITSH: (762027) SOLLEVAMENTO--PESI BIOMECANICA; (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA
SX: This document is available via SIRCExpress Order Number 479967, https://secure.sportquest.com/su.cfm?articleno=479967&title=479967

TI: Heart rate and match analysis in pre-pubescent soccer players

(Frequence cardiaque et analyse de l' effort en match pour des joueurs de football prepuberes.)
AU: Capranica,-L; Tessitore,-A; Guidetti,-L; Figura,-F
SO: Journal-of-sports-sciences-(London) 19(6), June 2001, 379-384, Total No. of Pages: 6
PY: 2001
LE: Advanced
DE: HEART-RATE; PREPUBESCENT-; SOCCER-; MATCH-ANALYSIS; LACTATE-; CHILD-; COMPARATIVE-STUDY
SH: (576033) SOCCER CHILDREN; (576310) SOCCER TESTING-AND-EVALUATION; (979400) PHYSIOLOGY-CARDIOVASCULAR-HEMODYNAMICS; (980350) PHYSIOLOGY-ENERGY-METABOLISM-LACTATE

AB: The aim of this study was to compare match analysis (using video recordings) and the physiological load (heart rate measured every 5 s, blood lactate measured after the warm-up, first half and second half) of six 11-year-old soccer players during official games of eleven-a-side on a regular-sized pitch (100 x 65 m) and of seven-a-side on a smaller pitch (60 x 40 m). In both games, heart rate exceeded 170 beats.min-1 84 % of the time, while blood lactate ranged from 1.4 to 8.1 mmol.1-1. No significant differences were recorded for the physiological parameters. For both matches, walking comprised 38 % of total time, running 55 %, inactivity 3 % and jumping 3 %. Although there were no significant differences between halves or matches, running for less than 10 s was 10 % more frequent in the seven-a-side game. In the seven-a-side game, there were significantly more passes and significantly fewer tackles, suggesting that seven-a-side matches played on smaller pitches may be more suitable for pre-pubescent soccer players.

ITSH: (576033) CALCIO BAMBINI; (576310) CALCIO TEST; (979400) FISIOLOGIA-CARDIOVASCOLARE-CIRCOLAZIONE-DEL-SANGUE; (980350) FISIOLOGIA-METABOLISMO-ENERGETICO-LATTATO
CL: RC1200 #700

Record 39 of 281 - SPORT Discus

TI: Analysis of hammer handle performance and safety. (Analisis del Rendimiento de la Manija del Martillo y Seguridad.) (Analyse des performances et de la securite des manches des marteaux.)

AU: Cardenas,-H
SO: New-studies-in-athletics-(Aachen) 18(1), Mar 2003, 47-50, Total No. of Pages: 4
PY: 2003
LE: Advanced
DE: HAMMER-THROW; SAFETY-; EQUIPMENT-
SH: (748162) HAMMER-THROW SAFETY
AB: The dimensional stability of hammer handles carne into question at the 2000 Olympic Games in Sydney when an implement that stretched during the competition became popular among the throwers. While initial attention focused on the violation of the relevant rule, another consideration regarding implement safety also surfaced. In this work, the forces and stresses acting on' the hammer handle are explored with the aim of reducing exposure to injury and ensuring the fairness of the competition. Video analysis of the implement velocity was used to calculate an estimated handle force. This force was used to demonstrate vulnerability of current handle specifications in regard to injury as well as deformations that could generate an unfair advantage. These findings were used to develop a proposed handle specification that requires the presence of a crossbar, which reduces the likelihood of injury while minimizing stretch.
ITSH: (748162) LANCIO-DEL-MARTELLO SICUREZZA
CL: GV1060.5 P4 #1260

Record 40 of 281 - SPORT Discus

TI: The relationship between selected blood lactate thresholds and match performance in elite soccer referees

AU: Castagna,-C; Abt,-G; D'-Ottavio,-S
SO: Journal-of-strength-and-conditioning-research-(Lawrence,-Kan.) 16(4), Nov 2002, 623-627, Total No. of Pages: 5
PY: 2002
LE: Advanced
DE: SOCCER-; REFEREE-; OFFICIATING-; MATCH-ANALYSIS; LACTATE-; CORRELATION-; RUNNING-; SPEED-
SH: (576127) SOCCER PHYSIOLOGY; (576117) SOCCER OFFICIATING
AB: The aim of this study was to examine the relationship between selected blood lactate thresholds and competitive match activities in elite soccer referees. Eight elite-level referees (mean age, 37.6 3.4 years) were each observed during 2 Serie A matches (n = 16), and the mean of each match activity was used for analysis. Match activities were monitored using a technology similar to that reported by Ohashi and others (20). Blood lactate thresholds were assessed under field conditions during a progressive multistage protocol. Running velocities attained at selected blood lactate concentrations (2 and 4 mmol.L-1, V2 and V4, respectively) were chosen because these are commonly used to assess endurance performance. Analyses of correlations were performed considering V2 and V4 values as independent variables and total distance, maximal velocity distance (runs performed at velocities faster than 24 km.h-1) and high-intensity activity distance (runs performed at velocities faster than 18 km.h-1) as dependent variables. Significance was set at p is less than or equal to 0.05 for all measurements. The V2 and V4 values were 10.9 1.8 km.h-1 and 13.6 1.4 km.h-1 (10.5 -

15.0), respectively. Mean peak-lactate corresponded to 9.4 1.6 mmol.L-1. The V4 value correlated moderately with the total distance covered during the match (r = 0.73, p < 0.05). The results demonstrate the positive relationship of the running velocity attained at a blood lactate concentration of 4 mmo1.L-1 to the total amount of distance covered by a referee during a match.

ITSH: (576127) CALCIO FISIOLOGIA; (576117) CALCIO ARBITRAGGIO
CL: GV546 P4 #204
SX: This document is available via SIRCExpress Order Number S-858793, https://secure.sportquest.com/su.cfm?articleno=S-858793&title=S-858793

Record 41 of 281 - SPORT Discus

TI: Relation between fitness tests and match performance in elite Italian soccer referees

AU: Castagna,-C; Abt,-G; D'-Ottavio,-S
SO: Journal-of-strength-and-conditioning-research-(Lawrence,-Kan.) 16(2), May 2002, 231-235, Total No. of Pages: 5
PY: 2002
LE: Advanced
DE: SOCCER-; REFEREE-; FIELD-TEST; MATCH-ANALYSIS; VIDEOTAPING-; ADULT-; COOPER'-S-12-MINUTE-RUN-TEST; AEROBIC-CAPACITY; ITALY-
SH: (576117) SOCCER OFFICIATING; (903240) OFFICIATING-PHYSICAL-FITNESS
AB: This study examined the relation between field-test results and match performance in elite Italian soccer referees. Subjects (n = 22) were all experienced elite-level referees enrolled in the Commissione Arbitri Nazionali (CAN) and thus officiating in the Serie A and B Italian championships. Referees were, on separate occasions, tested for fitness (50-m, 200-m, and 12-minute run tests) and observed a minimum of 1 and a maximum of 3 times (n = 39) during Serie A matches. Match analyses were performed considering 11 match activity categories. Analyses of correlations were performed considering 50-m, 200-m, and 12-minute run test performances as independent variables and total distance, maximal speed distance (runs performed at speeds faster than 24 km.h-1), and high-intensity activity distance (runs performed at speeds faster than 18 km.h-1, high intensity activity HIA)) as dependent variables. Statistical significance was set at p less than or equal to 0.05. In the 50-m, 200-m, and 12-minute run tests the referees scored, 7.07 0.26 seconds, 29.57 1.44 seconds, and 2866 164 m, respectively. The 12-minute run test showed a moderate correlation with total match distance (r = 0.71, p < 0.05), and a low correlation with HIA and maximal speed distance (r = 0.51, p < 0.05 and r = 0.32, p < 0.05, respectively). The 200-m and 50-m sprint times were not correlated with the distance covered at maximal speed or HIA, but correlated negatively with match distance (r = -0.48, p < 0.05 and r = -0.38, p < 0.05, respectively). The results of the present study demonstrate that the 12-minute run test is a moderate predictor of match performance in elite referees and that aerobic fitness should have priority in the physical conditioning programs of the elite soccer referee.

ITSH: (576117) CALCIO ARBITRAGGIO; (903240) ARBITRAGGIO-CONDIZIONE-FISICA
CL: GV546 P4 #204
SX: This document is available via SIRCExpress Order Number S-824994, https://secure.sportquest.com/su.cfm?articleno=S-824994&title=S-824994

Record 42 of 281 - SPORT Discus

TI: An investigation of the influence of bi-lateral deficit on human jumping

AU: Challis,-J-H
SO: Human-movement-science-(Amsterdam) 17(3), June 1998, 307-325, Total No. of Pages: 19
PY: 1998
LE: Advanced
DE: KINEMATICS-; KINETICS-; VERTICAL-JUMP; SKILL-; WOMAN-; BASKETBALL-
SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS; (546027) BASKETBALL BIOMECHANICS; (900750) COACHING-BIOMECHANICS
AB: The purpose of this study was to investigate the influence of bi-lateral deficit on one- and two-legged maximal vertical jumps. Seven female subjects (height 1.68 plus/minus 0.03 m, mass 64.39 plus/minus 6.93 kg) performed maximum vertical jumps with no counter movement from their preferred jumping leg and from both legs. Force plate and video analysis were used to determine the kinematics and kinetics of the activity. The minimum and maximum ankle,

knee and hip joint angles for the two jump conditions were not significantly different, indicating similar ranges of motion used in both types of jump. The height jumped from one leg was significantly different from being 50 percent of that jumped from two legs; the height jumped from one leg was 58.1 percent of that jumped from two. The general pattern of the angular velocities and resultant joint moments in these jumps indicated that the sequencing of joint extensions was similar regardless of jump condition. A simple model of jumping was presented. Simulations of one and two-legged jumping, using the model, indicated that the bi-lateral deficit was predominantly responsible for the differences in jump heights observed experimentally.

ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (546027) PALLACANESTRO BIOMECANICA; (900750) ALLENAMENTO-BIOMECCANICA

CL: QP302.P4 #140

SX: This document is available via SIRCExpress Order Number 494364, https://secure.sportquest.com/su.cfm?articleno=494364&title=494364

Record 43 of 281 - SPORT Discus

TI: Tendency of development of table tennis match seen from the changes of the recent rules

AU: Chen,-X-H; Huang,-L-Q

SO: Journal-of-Wuhan-institute-of-physical-education-(Wuhan,-P.R.China) 36(1), 2002, 76-77;116, Total No. of Pages: 3

PY: 2002

LE: Intermediate

DE: RULE-; TABLE-TENNIS; MATCH-ANALYSIS; TREND-ANALYSIS

SH: (706159) TABLE-TENNIS RULES-AND-REGULATIONS

AB: Modern table tennis techniques are at the peak of their development. Therefore it is difficult to make any breakthroughs. There have been changes to the batting instrument, but the functions of them are not significant. The development of table tennis is subject to the change of the competition rules. The recent use of big balls, the unblocking of service, the change of Eleven Points Recording will influence the players skills and techniques. Training theories and methods can be enriched and perfected and consequently table tennis game can be more developed.

ITSH: (706159) TENNIS-TAVOLO REGOLA

Record 44 of 281 - SPORT Discus

TI: Periodic arrangement of Chinese basketball major leagues of men and control of competitive readiness of players

AU: Chen,-Z

SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 20(3), Sept 1997, 60-66, Total No. of Pages: 7

PY: 1997

LE: Advanced

DE: BASKETBALL-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA; MAN-; CIRCADIAN-RHYTHM; COMPETITIVE-BEHAVIOUR; MAJOR-LEAGUE

SH: (546310) BASKETBALL TESTING-AND-EVALUATION

AB: The periodic arrangement of 12 teams, taking part in the Chinese basketball major leagues of men in the year of 1995 to 1996, and the control of the competitive readiness of the players were investigated and analyzed. The results showed that there was no essential distinction between the periodic division in basketball major leagues of men and traditional theory of single period and double periods. Their remarkable distinction was the relatively longer competitive phase. The whole competitive phase consisted of many circles (the three-day type and the four-day type). The suitable span of the preparatory phase in the basketball major league of men should be two months. The training time of the three-day type circle in the competitive phase was 3d or 2d, and that of the four-day type circle was 4d or 3d. The characteristics of the competitive readiness of the players, taking part in the major league of men, was waved. In controlling the competitive readiness of players the relationship between the phases and the circles should be well dealt.

ITSH: (546310) PALLACANESTRO TEST

SX: This document is available via SIRCExpress Order Number 454210, https://secure.sportquest.com/su.cfm?articleno=454210&title=454210

Record 45 of 281 - SPORT Discus

TI: Developmental tendencies of modern basketball viewed from the 2000-2001 yearly NBA play-off matches

AU: Cheng,-X-J

SO: Journal-of-Chengdu-physical-education-institute-(Chengdu,-P.R.China) 28(1), 2002, 73-75, Total No. of Pages: 3

PY: 2002

LE: Advanced

DE: BASKETBALL-; NATIONAL-BASKETBALL-ASSOCIATION; MATCH-ANALYSIS; TREND-ANALYSIS; EVALUATION-

SH: (546180) BASKETBALL STRATEGY

AB: Library research, observation, statistics, inductive reasoning etc. are adopted in the present paper. The 2000-2001 yearly U.S NBA League Play-off matches are analyzed and studied, and it is considered that the modern game of basketball manifests the following tendencies: taller players are selected; bigger players combine their body-height with strength and skills, and smaller ones are quicker, more accurate and comprehensive; the rhythm is faster in offensive and defensive stages, and attacks and defenses switch more and more quickly; powerful defenses are more prevalent at the play-off games; basketball stars' performance plays a significant part during matches; battles of wits and courage continue throughout the games; the spirits of collectivism and exerting the utmost strength have an important effect on the team's achievement; players with younger and ever greater strength are required at NBA League matches.

ITSH: (546180) PALLACANESTRO TATTICA

Record 46 of 281 - SPORT Discus

TI: A new index of coordination for the crawl: description and usefulness

AU: Chollet,-D; Chalies,-S; Chatard,-J-C

SO: International-journal-of-sports-medicine-(Stuttgart) 21(1), Jan 2000, 54-59, Total No. of Pages: 6

PY: 2000

LE: Advanced

DE: BIOMECHANICS-; SWIMMING-; CRAWL-; COORDINATION-

SH: (408027) SWIMMING BIOMECHANICS; (408220) SWIMMING TECHNIQUES-AND-SKILLS-CRAWL; (971460) PERCEPTUAL-MOTOR-PROCESSES-MOTOR-COORDINATION

AB: This study analyzes stroke phases and arm and leg coordination during front crawl swimming as a function of swim velocity and performance level. Forty-three swimmers constituted three groups based on performance level. All swam at three different swim velocities, corresponding to the paces appropriate for the 800 m, 100 m, and 50 m. The different stroke phases and the arm and leg coordination were identified by video analysis. Arm coordination was quantified using a new index of coordination (IdC), which expresses the three major modalities opposition, catch-up and superposition. Opposition, where one arm begins the pull phase when the other is finishing the push phase; catch up, which has a lag time (LT) between propulsive phases of the two arms; and superposition, which describes an overlap in the propulsive phases. The IdC is an index which characterizes coordination patterns by measure of LT between propulsive phases of each arm. The most important results showed that duration of the propulsive phases (B C) increased significantly with increasing velocity: 43.1 plus/minus 3.3 % for V800; 46.5 plus/minus 3 % for V100 and 49 plus/minus 3 % for V50. The arm and leg synchronization was modified in the sense of an increase in six-beat kick. The IdC increased significantly with velocity: IdCV800=-7.6 plus/minus 6.4 %; IdCV100 = - 3.2 plus/minus 5.1 % and IdCV50 = -0.9 plus/minus 5.6 %. IdC increased also significantly with performance level: IdCG3 = - 6.07 plus/minus 5.3 %; IdCG2 = -3.9 plus/minus 4.2 % and IdCG1= -1.76 plus/minus 5.6 % for the mean of the 3 velocity. The two extreme IdC were IDCG3V800 = - 9.4 plus/minus 5.4 % and IdCG1V50 = 2.53 plus/minus 4.4 %.

ITSH: (408027) NUOTO BIOMECANICA; (408220) NUOTO TECNICO-CRAWL; (971460) APPRENDIMENTO-PERCETTIVO-MOTOR-COORDINAZIONE-MOTORIA

CL: RC1200 #580

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Record 47 of 281 - SPORT Discus

TI: Exercise intensity and metabolic response in singles tennis

AU: Christmass,-M-A; Richmond,-S-E; Cable,-N-T; Arthur,-P-G; Hartmann,-P-E

SO: Journal-of-sports-sciences-(London) 16(8), Nov 1998, 739-747, Total No. of Pages: 9

PY: 1998

LE: Advanced

DE: TENNIS-; ATHLETE-; TRAINING-LOAD; METABOLISM-; HEART-RATE

SH: (708127) TENNIS PHYSIOLOGY

AB: The aim of this study was to determine exercise intensity and metabolic response during singles tennis play. Techniques for assessment of exercise intensity were studied on-court and in the laboratory. The on-court study required eight State-level tennis players to complete a competitive singles tennis match. During the laboratory study, a separate group of seven male subjects performed an intermittent and a continuous treadmill run. During tennis play, heart rate (HR) and relative exercise intensity (72 plus/minus 1.9 percent VO2max; estimated from measurement of heart rate) remained constant (83.4 plus/minus 0.9 percent HRmax; mean plus/minus sx) after the second change of end. The peak value for estimated play intensity (1.25 plus/minus 0.11 steps.s-1; from video analysis) occurred after the fourth change of end (P less than 0.05). Plasma lactate concentration, measured at rest and at the change of ends, increased 175 percent from 2.13 plus/minus 0.32 mmol.l-1 at rest to a peak 5.86 plus/minus 1.33 mmol.l-1 after the sixth change of end (P less than 0.001). A linear regression model, which included significant terms for percent HRmax (P less than 0.001), estimated play intensity (P less than 0.001) and subject (P less than 0.001), as well as a percent HRmax by subject interaction (P less than 0.05), accounted for 82 percent of the variation in plasma lactate concentration. During intermittent laboratory treadmill running, percent VO2peak estimated from heart rate was 17 percent higher than the value derived from the measured VO2 (79.7 plus/minus 2.2 percent and 69.0 plus/minus 2.5 percent VO2peak respectively; P less than 0.001). The percent VO2peak was estimated with reasonable accuracy during continuous treadmill running (5 percent error). We conclude that changes in exercise intensity based on measurements of heart rate and a time-motion analysis of court movement patterns explain the variation in lactate concentration observed during singles tennis, and that measuring heart rate during play, in association with preliminary fitness tests to estimate VO2, will overestimate the aerobic response.

ITSH: (708127) TENNIS FISIOLOGIA

CL: RC1200 #700

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Record 48 of 281 - SPORT Discus

TI: Evaluation of free shot contribution in winning a basketball game during European championships

AU: Christoforidis,-C; Papadimitriou,-K; Taxildaris,-K; Aggelousis,-N; Gourgoulis,-V

SO: Exercise-and-society-journal-of-sport-science-(Komotini) (24), 2000, 68-72, Total No. of Pages: 5

PY: 2000

LE: Advanced

DE: BASKETBALL-; FREE-THROW; MATCH-ANALYSIS; VIDEOTAPE-; VISUAL-FEEDBACK; GREECE-

SH: (546310) BASKETBALL TESTING-AND-EVALUATION; (909460) GREECE

AB: The proper evaluation of a basketball game is of vital concern for the coach nowadays. It can be reliably carried out by means of advanced technology. The purpose of the present study was the evaluation of free shot contribution in winning a game. Specifically, the VICAS software was implemented to record and analyze the free shots in 30 games of Greek basketball teams, which participated in the European Championships, the European Cup and the Croats Cup during the period 1994-96. The Greek teams won 17 of the games and were defeated in the rest 13 games. The Chi-square test was used for the statistical treatment of the data using the SPSS software. The results indicated that when Greek teams won, they performed significantly more free shots and at the same time they had significantly fewer points than their opponents from free throws did. On the contrary, when Greek teams were defeated they lost significantly more free shots than their opponents.

ITSH: (546310) PALLACANESTRO TEST; (909460) GRECIA

CL: GV701.P4 #1800

SX: This document is available via SIRCExpress Order Number S-657713, https://secure.sportquest.com/su.cfm?articleno=S-657713&title=S-657713

Record 49 of 281 - SPORT Discus

TI: Variations in random pairing finals systems

AU: Christos,-G
PB: In, Proceedings of the Fifth Australian Conference on Mathematics and Computers in Sport, Sydney, University of Technology, 2000, p.66-75, Total No. of Pages: 10
CN: Mathematics and Computers in Sport (5th : 2000 : Sydney)
PY: 2000
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; MATCH-ANALYSIS; PROBABILITY-; COMPETITION-
SH: (542110) AUSTRALIAN-FOOTBALL MATHEMATICS
ITSH: (542110) FOOTBALL-AUSTRALIANO MATEMATICA

TI: A preliminary study of "three-vs-three basket match" of mass sports

AU: Chu,-X; Ai,-X-N
SO: Journal-of-Wuhan-institute-of-physical-education-(Wuhan,-P.R.China) 36(1), 2002, 78-79, Total No. of Pages: 2
PY: 2002
LE: Intermediate
DE: BASKETBALL-; MATCH-ANALYSIS; SPORT-FOR-ALL; PHYSICAL-FITNESS; EVALUATION-
SH: (972980) PHYSICAL-FITNESS-SPORT-FOR-ALL; (546123) BASKETBALL PHYSICAL-FITNESS
AB: Three-vs-three basketball match is a simple and practical event of mass sports, which is both interesting and attractive. It is an entertaining match with high popularity. The inner value of the match can promote the development of mass sports and it can play an important role in implementing the nation wide program of fitness.
ITSH: (972980) CONDIZIONE-FISICA-SPORT-PER-TUTTI; (546123) PALLACANESTRO CONDIZIONE-FISICA

TI: A technical-tactical analysis of freestyle wrestling

AU: Cipriano,-N
SO: Journal-of-strength-and-conditioning-research-(Champaign,-Ill.) 7(3), Aug 1993, 133-140
PY: 1993
LE: Advanced
DE: FREESTYLE-WRESTLING; TECHNIQUE-; STRATEGY-; COMPARATIVE-STUDY; MATCH-ANALYSIS; WRESTLING-
SH: (604192) WRESTLING TECHNIQUES-AND-SKILLS; (604180) WRESTLING STRATEGY
AB: This study investigated the technical-tactical profile of freestyle wrestling to determine the effects of altering the match duration and format from the previous 2X3-min periods with 1 min rest in between to current 1X5-min period. Match profiles were determined by analyzing 472 matches at major international events using a computerized scouting package interfaced with a standard video cassette recorder. Individual weight class profiles and top 10 team profiles were produced by analyzing 347 and 367 matches, respectively. Results indicate that freestyle wrestlers rely predominantly on leg attacks to score the takedown, and to a much lesser extent on throwing actions. Techniques were remarkably similar for all weight classes. The 52-kg-class competitors scored the most points per match while the 90-kg-class wrestlers recorded the lowest. Passivity infractions were highest in the heavyweight and lowest in the lightweight classes. In parterre wrestling, the gut wrench and cross ankle techniques were used the most. Under the 1X5-min format, there was a 12 percent increase in the number of points scored in the first 3 min of play and a 17 percent decrease in the total points per match.
ITSH: (604192) LOTTA TECNICO; (604180) LOTTA TATTICA
CL: GV546.P4 #204
SX: This document is available via SIRCExpress Order Number 341035, https://secure.sportquest.com/su.cfm?articleno=341035&title=341035

TI: Profilo biomeccanico della tecnica di passaggio di Colin Jackson

AU: Coh,-M
SO: Atleticastudi-(Rome) 34(1), Jan/Mar 2003, 33-40, Total No. of Pages: 8
PY: 2003
LE: Advanced
DE: HURDLE-RACE; TECHNIQUE-; BIOMECHANICS-; THREE-DIMENSIONAL-DISPLAY-SYSTEM; JACKSON,-C.; STATISTICS-; STRIDE-LENGTH; THEORETICAL-MODEL; HURDLE-; KINEMATICS-
SH: (732027) HURDLE-RACE BIOMECHANICS
AB: During a competition, which took place in Slovenia, the technique of Colin Jackson's hurdles clearance is studied. A group of experts of Biomechanics Laboratory of the Faculty of sport in Lubiana made some biomechanical measurements. The main purpose of this study was of defining a kinematic model of hurdle clearance technique on the fourth hurdle and a rhythmic model of the run from the fourth to the fifth hurdle through the three dimensional video analysis. The various biomechanical parameters related to the hurdle clearance technique are reported.
ITDE: tecnica-; biomeccanical-; analisi-tridimensionale; 110hs-; Jackson,-C.; statistica-; ampiezza-del-passo; modello-teorico; ostacolo-; cinematica-
ITAB: In occasione di una gara svolta in Slovenia, viene analizzata la tecnica del passaggio degli ostacoli di Colin Jackson. Un gruppo di esperti del Laboratorio di Biomeccanica della Facolta' dello Sport di Lubiana ha effettuato misurazioni biomeccaniche. L' obiettivo principale di questo studio e' stato quello di stabilire un modello cinematico della tecnica di passaggio sul quarto ostacolo e un modello ritmico della corsa dal quarto al quinto ostacolo attraverso un'analisi video tridimensionale. Vengono indicati i vari parametri biomeccanica collegati alla tecnica del superamento dell'ostacolo.
ITSH: (732027) CORSA-GARA-AD-OSTACOLI BIOMECANICA

Record 53 of 281 - SPORT Discus

TI: Kinematic and kinetic parameters of the sprint start and start acceleration model of top sprinters

AU: Coh,-M; Jost,-B; Skof,-B; Tomazin,-K; Dolenec,-A
SO: Gymnica-(Olomouc) 281998, 33-42, Total No. of Pages: 10
PY: 1998
LE: Advanced
DE: KINEMATICS-; KINETICS-; SPRINTING-; SPRINT-START; ACCELERATION-; THEORETICAL-MODEL; TESTING-; ELITE-ATHLETE
SH: (740027) SPRINTING BIOMECHANICS
AB: The purpose of the research was to find the most important kinematic and kinetic parameters of the set position and starting action and their correlation with the start acceleration. The subject sample comprised of thirteen male sprinters and eleven female sprinters. A 2D kinematic analysis video system (APAS) was used to register the kinematic start and start acceleration parameters. The kinetic parameters of the starting action were measured with the help of modified starting blocks (MMIP) with in-built measurement sensors. The time parameters of the start acceleration were measured by four pairs of photo cells (AMES) placed at 5-10-20-30 m from the starting line. The statistical analysis was performed with the statistical package SPSS. The efficiently of the sprint start for both sexes is generated by: horizontal start velocity of the C.G., starting reaction time, force impulse and the maximal force gradient on the front starting block. Significant differences ($p < 0.05$) between the genders are predominantly in the area of kinetic parameters of the starting action. The highest correlations with the start acceleration for male sprinters has the kinetic parameters block of the starting action - maximal and relative force of pressure, maximal force gradient, force impulse and time to maximal force'; among the kinematic parameters horizontal start velocity of the C.G. and the ankle angle in the front starting block. Female sprinters have much lower correlations, only two significant coefficients were obtained - time to maximal force on the front and rear starting block. The generally low correlations between the start and the start acceleration, especially in the first five metres from the start are the consequence of the differences in the biomechanical motor structure.
ITSH: (740027) CORSA-CORSE-DI-VELOCITA BIOMECANICA

TI: A comparison of the intra-cycle velocity variation in breaststroke swimmers with flat and undulating styles

AU: Colman,-V; Persyn,-U; Daly,-D; Stijnen,-V
SO: Journal-of-sports-sciences-(London) 16(7), Oct 1998, 653-665, Total No. of Pages: 13
PY: 1998
LE: Advanced
DE: SWIMMING-; BREASTSTROKE-; CENTRE-OF-GRAVITY; SPEED-; VIDEOTAPE-; VISUAL-FEEDBACK;
COMPARATIVE-STUDY
SH: (408212) SWIMMING TECHNIQUES-AND-SKILLS-BREASTSTROKE; (946855) BIOMECHANICS-TECHNIQUE-
CENTRE-OF-GRAVITY; (946700) BIOMECHANICS-SKILLS-ANALYSIS

AB: The aim of this study was to establish differences in intra-cyclic horizontal velocity variation of the body's centre of mass in breaststroke swimmers with flat and undulating styles. Vertical eel-like body waving and trunk rotations were measured to distinguish styles. To reconstruct trunk extension and kyphosis in the poorly visible zone close to the water surface, a semi-automated video-analysis system was developed. From 45 international-level swimmers examined, two groups of women and two groups of men were identified, those using the most undulating and those using the flattest styles. Among the men with the flattest style, the maximum and minimum horizontal velocity of the body's centre of mass differed by 76 percent from the mean swimming velocity; among the women with the most undulating style, the figure was 53 percent. In the most undulating style, less horizontal velocity variation of the body's centre of mass could be explained by movements of the body parts above the water surface, creating a transfer of momentum: a quick backward upper trunk rotation generates resistance and a quick forward shoulder girdle and upper arm movement, followed by a quick forward upper trunk and head rotation, generates propulsion. In addition, during an upward leg kick, some swimmers generated propulsion similar to that seen in eels.
ITSH: (408212)   NUOTO   TECNICO-RANA;   (946855)   BIOMECCANICA-CENTRO-DI-GRAVITA;   (946700)
BIOMECCANICA-ANALISI-DELLE-ABILITA

TI: Physiological responses during a professional rugby league match - abstract

AU: Coutts,-A; Reaburn,-P
CA: Australian-Conference-of-Science-and-Medicine-in-Sport-2001-:-Perth,; Sports-Medicine-Australia
PB: In Sports Medicine Australia, 2001: a sports medicine odyssey: challenges, controversies and change: Australian Conference of Science and Medicine in Sport 23-27 October 2001, Perth, WA, Dickson, A.C.T., Sports Medicine Australia, c2001, p.105, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2001/acsms/papers/COUT.pdf
CN: Australian Conference of Science and Medicine in Sport (2001 : Perth, Western Australia)
PY: 2001
LE: Advanced
DE: RUGBY-LEAGUE; MATCH-ANALYSIS; ENERGY-EXPENDITURE; LACTATE-; HEART-RATE
SH: (575127) RUGBY-LEAGUE PHYSIOLOGY
ITSH: (575127) RUGBY-LEAGUE FISIOLOGIA

TI: Heart rate, blood lactate concentration and estimated energy expenditure in a semi-professional rugby league team during a match: a case study

AU: Coutts,-A; Reaburn,-P; Abt,-G
SO: Journal-of-sports-sciences-(London) 21(2), Feb 2003, 97-103, Total No. of Pages: 7
PY: 2003
LE: Advanced
DE: RUGBY-LEAGUE; HEART-RATE; ENERGY-EXPENDITURE; LACTATE-; MATCH-ANALYSIS; CASE-STUDY
SH: (575127) RUGBY-LEAGUE PHYSIOLOGY; (980350) PHYSIOLOGY-ENERGY-METABOLISM-LACTATE; (979400) PHYSIOLOGY-CARDIOVASCULAR-HEMODYNAMICS; (980200) PHYSIOLOGY-ENERGY-METABOLISM-ENERGY-COST

AB: The aim of this study was to examine heart rate, blood lactate concentration and estimated energy expenditure during a competitive rugby league match. Seventeen well-trained rugby league players (age, 23.9 4.1 years; VO2max, 57.9 3.6 ml.kg-1.min-1; height, 1.82 0.06 m; body mass, 90.2 9.6 kg; mean s) participated in the study. Heart rate was recorded continuously throughout the match using Polar Vantage NV recordable heart rate monitors. Blood lactate samples (n = 102) were taken before the match, after the warm-up, at random stoppages in play, at half time and immediately after the match. Estimated energy expenditure during the match was calculated from the heart rate-VO2 relationship determined in laboratory tests. The mean team heart rate (n= 15) was not significantly different between halves (167 9 vs 165 11 beats.min-1). Mean match intensity was 81.1 5.8 % VO2max. Mean match blood lactate concentration was 7.2 2.5 mmol-1-1, with concentrations for the first half (8.4 1.8 mmol.1-1) being significantly higher than those for the second half (5.9 2.5 mmol.1-1) (P < 0.05). Energy expenditure was approximately 7.9 MJ. These results demonstrate that semi-professional rugby league is a highly aerobic game with a considerable anaerobic component requiring high lactate tolerance. Training programmes should reflect these demands placed on players during competitive match-play.

ITSH: (575127) RUGBY-LEAGUE FISIOLOGIA; (980350) FISIOLOGIA-METABOLISMO-ENERGETICO-LATTATO; (979400) FISIOLOGIA-CARDIOVASCOLARE-CIRCOLAZIONE-DEL-SANGUE; (980200) FISIOLOGIA-METABOLISMO-ENERGETICO-COSTO-ENERGETICO
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-864813, https://secure.sportquest.com/su.cfm?articleno=S-864813&title=S-864813

Record 59 of 281 - SPORT Discus

TI: Using computers and scientific method to determine optimal strategies in tennis

AU: Croucher,-J-S
PB: In, Mathematics and computers in sport: a conference held at Bond University, Queensland, Australia 13th to 15th July 1998, [Queensland], [Bond University], 1998, p.1-14
CN: Mathematics and Computers in Sport (4th : 1998 : Queensland)
PY: 1998
LE: Intermediate
DE: TENNIS-; MATHEMATICS-; SERVE-; STRATEGY-; PROBABILITY-; NOTATION-; MATCH-ANALYSIS
SH: (708110) TENNIS MATHEMATICS
ITSH: (708110) TENNIS MATEMATICA

Record 60 of 281 - SPORT Discus

TI: Analisis tactico del juego del Deportivo de La Coruna 1999/00

(Tactical analysis of the playing style of the Deportivo de la Coruna in the 1999-2000 season.)
AU: Cuevas-Campos,-R; Moreno-Casado,-H
SO: Lecturas:-educacion-fisica-y-deportes-(Buenos-Aires) 7(35 segunda quincena), Apr 2001
URL: http://www.efdeportes.com/efd35/lacoru.htm
PY: 2001
LE: Advanced

DE: SOCCER-; TEAM-; SPAIN-; STRATEGY-; MATCH-ANALYSIS
SH: (576180) SOCCER STRATEGY
ITSH: (576180) CALCIO TATTICA

Record 61 of 281 - SPORT Discus

TI: Activity profile of top level soccer referees during competitive matches

AU: D'-Ottavio,-S; Castagna,-C
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.151-156, Total No. of Pages: 6
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: SOCCER-; REFEREE-; ITALY-; STATISTICS-; MOVEMENT-; MATCH-ANALYSIS
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576117) SOCCER OFFICIATING
ITSH: (576310) CALCIO TEST; (576117) CALCIO ARBITRAGGIO

Record 62 of 281 - SPORT Discus

TI: Analysis of match activities in elite soccer referees during actual match play

AU: D'-Ottavio,-S; Castagna,-C
SO: Journal-of-strength-and-conditioning-research-(Lawrence,-Kan.) 15(2), May 2001, 167-171, Total No. of Pages: 5
PY: 2001
LE: Advanced
DE: SOCCER-; REFEREE-; MATCH-ANALYSIS; COMPETITION-; LONGITUDINAL-STUDY; PHYSIOLOGICAL-STRESS
SH: (576127) SOCCER PHYSIOLOGY; (576117) SOCCER OFFICIATING; (903255) OFFICIATING-PHYSIOLOGY
AB: This study describes the work-rate profile of Italian high-level soccer referees (N = 33). The referees were examined during official games (n = 96) of the 1992-1996 first division Italian championships (Series A). Subjects were all experienced, top-level referees enrolled in the Commissione Arbitri Nazionali and officiated in the Series A and B Italian championships. Mean age of the referees studied was 37.8 2.1 years. Match analysis was performed using a technology similar to that reported by Ohashi et al. in 1988. Average match distance was 11,469 983 m. Referees, on average, covered 17.2 % of the entire match distance at speeds faster than 18.1 km.h-1. A 4.1 % decrement of the total distance covered was evident during the second half (p < 0.001). Furthermore, less distances were covered running backward and sideways during the second half compared to the first half (p < 0.001). Nevertheless, the referees experienced no decrement in the distance covered at speeds faster than 18.1 km.h-1 throughout the match. Match analysis revealed the intermittent nature of the referees' activities. Their intensity varied from situation to situation, frequently reaching near maximal intensity. However, sprint bouts never lasted for more than a few seconds (2-4 seconds). Therefore, refereeing, at least at top level, places unique stresses on the officials, and thus specific training and fitness assessment are needed.
ITSH: (576127) CALCIO FISIOLOGIA; (576117) CALCIO ARBITRAGGIO; (903255) ARBITRAGGIO-FISIOLOGIA
CL: GV546 P4 #204
SX: This document is available via SIRCExpress Order Number S-779612, https://secure.sportquest.com/su.cfm?articleno=S-779612&title=S-779612

Record 63 of 281 - SPORT Discus

TI: The contribution of starting, turning, and finishing to total race performance in male paralympic swimmers

AU: Daly,-D-J; Malone,-L-A; Smith,-D-J; Vanlandewijck,-Y; Steadward,-R-D
SO: Adapted-physical-activity-quarterly-(Champaign,-Ill.) 18(3), July 2001, 316-333, Total No. of Pages: 18
PY: 2001

LE: Advanced

DE: PARALYMPIC-GAMES,-ATLANTA-1996; OLYMPIC-GAMES,-ATLANTA-1996; BACKSTROKE-; BREASTSTROKE-; BUTTERFLY-; FREESTYLE-; SPRINT-SWIMMING; 100-M.; START-; TURN-; FINISH-; TIME-FACTOR; SPEED-; CINEMATOGRAPHY-; VARIANCE-; MULTIPLE-REGRESSION-ANALYSIS; MATCH-ANALYSIS; COMPARATIVE-STUDY; ELITE-ATHLETE; MAN-

SH: (408027) SWIMMING BIOMECHANICS; (408054) SWIMMING DISABLED; (264393) OLYMPIC-GAMES-(SUMMER)-ATLANTA-1996 EVENTS; (230393) PARALYMPIC-GAMES-ATLANTA-1996 EVENTS

AB: A video race analysis was conducted at the Atlanta Paralympic Games swimming competition. The purpose was to describe the contribution of clean swimming speed, as well as start, turn, and finish speed, to the total race performance in the four strokes for the men's 100 m events. Start, turn, and finish times, as well as clean swimming speed during four race sections, were measured on videotapes during the preliminary heats (329 swims). Information on 1996 Olympic Games finalists (N = 16) was also available. In Paralympic swimmers, next to clean swimming speed, both turning and finishing were highly correlated with the end race results. Paralympic swimmers do start, turn, and finish slower than Olympic swimmers but in direct relation to their slower clean swimming speed. The race pattern of these components is not different between Paralympic and Olympic swimmers.

ITSH: (408027) NUOTO BIOMECANICA; (408054) NUOTO DISABILE; (264393) GIOCHI-OLIMPICI-(ESTIVI)-ATLANTA-1996 COMPETIZIONE; (230393) GIOCHI-PARAOLIMPICI-ATLANTA-1996 COMPETIZIONE

CL: GV201 #260

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Record 64 of 281 - SPORT Discus

TI: Playing patterns of elite and non-elite volleyball. (Poster Session)

AU: Daniel,-R; Hughes,-M

PB: In 12th Commonwealth International Sport conference, 19-23 July 2002, Manchester, United Kingdom: abstract book, London, Association of Commonwealth Universities, 2002, p.376, Total No. of Pages: 1

CN: Commonwealth International Sport Conference (12th : 2002 : Manchester).

PY: 2002

LE: Advanced

DE: VOLLEYBALL-; ELITE-ATHLETE; ATHLETE-; MATCH-ANALYSIS; PATTERN-; EVALUATION-; METHOD-; DESIGN-; TESTING-

SH: (588310) VOLLEYBALL TESTING-AND-EVALUATION

ITSH: (588310) PALLAVOLO TEST

CL: GV557.5 #35552

SX: This document is available via SIRCExpress Order Number S-840159, https://secure.sportquest.com/su.cfm?articleno=S-840159&title=S-840159

Record 65 of 281 - SPORT Discus

TI: Contributions of angular momentum and catting to the twist rotation in high jumping

(Contributions du mouvement angulaire et des actions et reactions (pendant la rotation longitudinale) sur la rotation longitudinale du corps en saut en hauteur.)

AU: Dapena,-J

SO: Journal-of-applied-biomechanics-(Champaign,-Ill.) 13(2), May 1997, 239-253, Total No. of Pages: 15

PY: 1997

LE: Advanced

DE: HIGH-JUMP; ANGULAR-MOMENTUM; TWIST-; ROTATION-; MAN-; WOMAN-

SH: (716027) HIGH-JUMP BIOMECHANICS; (946700) BIOMECHANICS-SKILLS-ANALYSIS; (946860) BIOMECHANICS-TECHNIQUE-CINEMATOGRAPHY

AB: This project sought to break down high jump twist rotation into portions contributed by angular momentum and those contributed by rotational action and reaction ("catting"). Five male and 5 female high jumpers were studied with three-dimensional film/video analysis procedures. The hip twist angle at the peak was broken down into an initial twist angle at takeoff and the subsequent twist rotation accumulated between takeoff and the peak. The latter was in turn

broken down into rotations contributed by the twisting component of angular momentum and rotations contributed by catting. It was found that the contribution of catting to the twist rotation was at least as large as that of the angular momentum. The important contribution of catting to the twist rotation introduces the possibility that defects in its execution might play a role in the problems that some high jumpers have with twist rotation.

ITSH: (716027) DI-SALTO-SALTO-IN-ALTO BIOMECANICA; (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (946860) BIOMECCANICA-CINEMATOGRAFIA

CL: QP302.P4 #21

SX: This document is available via SIRCExpress Order Number 420293, https://secure.sportquest.com/su.cfm?articleno=420293&title=420293

Record 66 of 281 - SPORT Discus

TI: A closer look at the shape of the high jump run-up

AU: Dapena,-J

SO: Track-coach-(Mountain-View,-Calif.) (138), Winter 1997, 4406-4411, Total No. of Pages: 6

PY: 1997

LE: Intermediate

DE: HIGH-JUMP; BIOMECHANICS-; RUN-UP

SH: (716027) HIGH-JUMP BIOMECHANICS; (716192) HIGH-JUMP TECHNIQUES-AND-SKILLS

AB: Thanks to some video analysis done by liboshi and his team, new information can now be plugged into the method for drawing the path of the high jumper's footprints on the ground. The original article by Dapena on this subject was in issue #131 of Track Coach. From this I gather elite jumpers have an unusual sense of finding the right spot to jump from. No matter what the differences are... they get the run-up to work. It is similar to Finnish javelin throwers, who may differ in the first part of the run, but who all seem to know what to do in the last two steps.

ITSH: (716027) DI-SALTO-SALTO-IN-ALTO BIOMECANICA; (716192) DI-SALTO-SALTO-IN-ALTO TECNICO

SX: This document is available via SIRCExpress Order Number 412891, https://secure.sportquest.com/su.cfm?articleno=412891&title=412891

Record 67 of 281 – SPOR

TI: Comparison of training activities and game demands in the Australian Football League

AU: Dawson,-B; Hopkinson,-R; Appleby,-B; Stewart,-G; Roberts,-C

SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 7(3), Sept 2004, 292-301, Total No. of Pages: 10

PY: 2004

LE: Advanced

DE: AUSTRALIAN-FOOTBALL; ELITE-ATHLETE; MOVEMENT-; PATTERN-; MATCH-ANALYSIS; TEAM-POSITION; TRAINING-; SPECIFICITY-OF-TRAINING; COMPARATIVE-STUDY

SH: (542310) AUSTRALIAN-FOOTBALL TESTING-AND-EVALUATION; (542192) AUSTRALIAN-FOOTBALL TECHNIQUES-AND-SKILLS

AB: This paper serves as a companion to our recent study of the movement patterns and game activities of players (from five different positions) during matches in the 2000 Australian Football League season. Using lapsed-time video analysis, the same individual players (n=11) as filmed in matches were also monitored during 21 in-season main training sessions conducted by their clubs in order to assess the degree to which training activities matched game demands. In general the training sessions did not involve physical pressure; therefore there were very few contested marks and ground balls or tackles, shepherds and spoils, thereby not matching these game demands. Players typically had more possessions (kicks and handballs) at training than in games. They also spent a greater percentage of total time standing and less time walking at training than in games. Fast-running and sprinting efforts at training were almost all for durations of <6 secs, which matched game demands, as did changes of direction when sprinting, which were almost all in a 0-90degree arc. However, across all players filmed, high intensity (fast-running and sprinting) movements were not performed as frequently at training (one every 76 secs) as in games (one every 51 secs). Therefore, while some game demands were adequately replicated at training others were not closely simulated suggesting that after careful interpretation of these results some improvements in training practices could be made.

ITSH: (542310) FOOTBALL-AUSTRALIANO TEST; (542192) FOOTBALL-AUSTRALIANO TECNICO

CL: RC1200 #2600:

SX: This document is available via SIRCExpress Order Number S-965821, https://secure.sportquest.com/su.cfm?articleno=S-965821&title=S-965821

TI: Player movement patterns and game activities in the AFL. (Abstract)

AU: Dawson,-B; Hopkinson,-R; Appleby,-B; Stewart,-G; Roberts,-C
CA: Australian-Conference-of-Science-and-Medicine-in-Sport-2002-:-Melbourne,
SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 5(4 Suppl), 2002, 33, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2002/acsms/Papers/Dawson1.asp
PY: 2002
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; PROFESSIONAL-; MATCH-ANALYSIS; MOVEMENT-; PATTERN-; TEAM-POSITION; VIDEOTAPING-; AUSTRALIA-
SH: (542310) AUSTRALIAN-FOOTBALL TESTING-AND-EVALUATION; (542192) AUSTRALIAN-FOOTBALL TECHNIQUES-AND-SKILLS
ITSH: (542310) FOOTBALL-AUSTRALIANO TEST; (542192) FOOTBALL-AUSTRALIANO TECNICO
CL: RC1200 #2600:
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-968245, https://secure.sportquest.com/su.cfm?articleno=S-968245&title=S-968245

Using video analysis, AFL players from five different positions (full forward/full back, centre half forward/centre half back, small forward/small back, mid fielders and ruckmen) had their movement patterns (stand, walk, jog, fast run, sprint, change of direction) and game activities (possessions, ruck duels, ground ball contests, shepherds, spoils, bumps and tackles) recorded in two games each in the 2000 season. The main findings were: a) full forward/full back were most different from the other positions, as they were seen to stand more and jog and fast run less; b) ruckmen and midfielders were involved in more game activities than the other positions; c) for all positions, there were over 150 high intensity movements (fast run plus sprint) in the game, but these accounted for only 4-6% of total movement time; d) virtually all of the high intensity movements lasted for <6s; e) over half of all sprints involved at least one change of direction, mostly within the 0-90o arc (left or right); f) all ground ball contests took <6s, with midfielders having 2-3 times as many as the other positions. Improvements in specific preseason and in-season training practices for different positions should be possible after careful interpretation of these findings.

TI: Player movement patterns and game activities in the Australian Football League

AU: Dawson,-B; Hopkinson,-R; Appleby,-B; Stewart,-G; Roberts,-C
SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 7(3), Sept 2004, 278-291, Total No. of Pages: 14
PY: 2004
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; ELITE-ATHLETE; MOVEMENT-; PATTERN-; MATCH-ANALYSIS; TEAM-POSITION; COMPARATIVE-STUDY
SH: (542310) AUSTRALIAN-FOOTBALL TESTING-AND-EVALUATION; (542192) AUSTRALIAN-FOOTBALL TECHNIQUES-AND-SKILLS
AB: In the Australian Football League (AFL), specific game movements and activities have not been studied since the 1970s and 1980s and the game is now much faster than it was 20-30 years ago. Using lapsed-time video analysis, AFL players from five different positions (full forward/full back, centre half forward/centre half back, small forward/small back, mid fielders and ruckmen) had their movement patterns (stand, walk, jog, fast-run, sprint, change of direction) and game activities (possessions, ruck duels, ground ball contests, shepherds, spoils, bumps and tackles) recorded in two games each in the 2000 season. A descriptive analysis of the results was undertaken. The main findings were: full forward/full back were most different from the other positions, as they were seen to stand more and jog and fast-run less; ruckmen and midfielders were involved in more game activities than the other positions; for all positions, there were more than 150 high intensity movements (fast-run plus sprint) in the game, but these accounted for only 4-6% of total movement time; virtually all of the high intensity movements lasted for <6 secs; more than half of all sprints involved at least one change of direction, mostly within the 0-90degree arc (left or right) and all ground ball contests took <6 secs, with

midfielders having 2-3 times as many as the other positions. Improvements in specific pre-season and in-season training practices for different positions should be possible after careful interpretation of these findings.
ITSH: (542310) FOOTBALL-AUSTRALIANO TEST; (542192) FOOTBALL-AUSTRALIANO TECNICO
CL: RC1200 #2600:
SX: This document is available via SIRCExpress Order Number S-965820, https://secure.sportquest.com/su.cfm?articleno=S-965820&title=S-965820

Record 70 of 281 - SPORT Discus

TI: Assessment of the mechanical properties of area-elastic sport surfaces with video analysis

AU: De-Koning,-J-J; Nigg,-B-M; Gerritsen,-K-G-M
SO: Medicine-and-science-in-sports-and-exercise-(Hagerstown,-Md.) 29(12), Dec 1997, 1664-1668, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: SURFACE-; MECHANICAL-PROPERTY; ELASTICITY-; EVALUATION-; GROUND-REACTION-FORCE
SH: (907580) FACILITIES-FLOORING
AB: Mechanical properties of a surface are assumed to be of importance with respect to injuries, comfort, and performance in sport. For a better understanding of the factors that do influence the etiology of injuries as well as comfort, a method was developed to compare mechanical characteristics of wooden area-elastic indoor surfaces. The method was based on video analysis of markers mounted on the surface during tests using human subjects performing movements. The method provided information concerning deflection, area-elasticity, and vibration. With the proposed methodology it was possible to direct differences with respect to these variables in differently built wooden sport surfaces. The accuracy of the analysis was greater than 0.1 mm. The results show that it was possible to use the proposed methodology in the assessment of the area-elastic wooden sport surfaces. This information may be at help in understanding the relation between surface characteristics and surface-related injuries, comfort, and possible fatigue.
ITSH: (907580) IMPIANTI-PAVIMENTAZIONE
CL: RC1200 #820
SX: This document is available via SIRCExpress Order Number 454844, https://secure.sportquest.com/su.cfm?articleno=454844&title=454844

Record 71 of 281 - SPORT Discus

TI: Analysis of relationships determining basketball players' efficiency

AU: Dembinski,-J
SO: Czlowiek-i-ruch-(Wroclaw,-Poland) 3(1), 2001, 123-128, Total No. of Pages: 6
PY: 2001
LE: Advanced
DE: BASKETBALL-; EFFICIENCY-; OFFENCE-; DEFENCE-; WINNING-; MATCH-ANALYSIS; VIDEOTAPE-; TEST-RELIABILITY; OBSERVATION-; RANKING-
SH: (546180) BASKETBALL STRATEGY; (546156) BASKETBALL RESEARCH-METHODS
AB: The aim of the present work is to identify the relationships between victory and the efficiency of offence and defense actions on the basis of modified forwards indicator (OER) and defense indicator (DER). On the basis of analysis of five video-recorded final play-off games in the first league men basketball in the season 1999/2000, and also on the basis of the results achieved, the following conclusions have been drawn: 1. The modifications of OER and DER indicators confirm the actual condition of a basketball game and allow quantification of offence and defense effectiveness. 2. A definite dominance of defense over offence has been observed. Thus there exists an urgent need to improve offensive abilities at the simultaneous sustaining present defense level.
ITSH: (546180) PALLACANESTRO TATTICA; (546156) PALLACANESTRO RICERCA-METODO
CL: QP302 P4 #320
SX: This document is available via SIRCExpress Order Number S-923027, https://secure.sportquest.com/su.cfm?articleno=S-923027&title=S-923027

Record 72 of 281 - SPORT Discus

TI: Strategic decisions of ice hockey coaches as a function of game location

AU: Dennis,-P-W; Carron,-A-V

SO: Journal-of-sports-sciences-(London) 17(4), Apr 1999, 263-268, Total No. of Pages: 6

PY: 1999

LE: Advanced

DE: HOCKEY-; COACHING-; STRATEGY-; DECISION-MAKING; GAME-LOCATION; HOME-ADVANTAGE; FORECHECKING-

SH: (464045) HOCKEY COACHING; (902595) COACHING-STRATEGY

AB: Two studies were performed to determine the influence of game location in the strategic decisions of ice hockey coaches. In study 1, coaches from the National (n = 23) and Ontario Hockey Leagues (n = 17) indicated the degree to which they had their teams forecheck assertively at home versus away. In study 2, video analysis of 62 National Hockey League games was used to verify the extent to which teams in this league use an assertive forechecking strategy at home versus away. In study 1, coaches reported that they implemented a more assertive forechecking style at home versus away (P < 0.001). The results of the video analysis in study 2 were consistent with the coaches' reports: teams used a more assertive forechecking style at home versus away (P < 0.03). The results are discussed in terms of their implications for the home advantage in the National Hockey League.

ITSH: (464045) HOCKEY-SU-GHIACCIO ALLENAMENTO; (902595) ALLENAMENTO-STRATEGIA

CL: RC1200 #700

SX: This document is available via SIRCExpress Order Number S-46509, https://secure.sportquest.com/su.cfm?articleno=S-46509&title=S-46509

Record 73 of 281 - SPORT Discus

TI: The relationship between game location and decisions by National Hockey League officials

AU: Dennis,-P-W; Carron,-A-V; Loughead,-T-M

SO: Avante-(Gloucester,-Ont.) 8(2), 2002, 67-73, Total No. of Pages: 7

PY: 2002

LE: Advanced

DE: HOME-ADVANTAGE; GAME-LOCATION; DECISION-MAKING; OFFICIATING-; VIDEOTAPING-; PENALTY-; HOCKEY-; NATIONAL-HOCKEY-LEAGUE

SH: (464117) HOCKEY OFFICIATING; (903285) OFFICIATING-PSYCHOLOGY

AB: The general purpose of the present study was to examine the influence of game location on the subjective decision-making of ice hockey officials. Video analysis of National Hockey League teams (n = 42 games analyzing both home and visitor performance) was used within a 2 (game location; home vs. away) X 2 (team penalty status; high- vs. low-penalized) factorial with incorrect officiating decisions used as the dependent variable. The results failed to show evidence of officiating bias; there was no difference in the number of incorrect officiating decisions against the home and visiting teams (p > .05). Implications for the home advantage are discussed.

ITSH: (464117) HOCKEY-SU-GHIACCIO ARBITRAGGIO; (903285) ARBITRAGGIO-PSICOLOGIA

CL: GV201 #5140

SX: This document is available via SIRCExpress Order Number S-856603, https://secure.sportquest.com/su.cfm?articleno=S-856603&title=S-856603

Record 74 of 281 - SPORT Discus

TI: A comparison of competition work rates in elite club and 'Super 12' rugby

AU: Deutsch,-M-U; Kearney,-G-A; Rehrer,-N-J

PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.160-166, Total No. of Pages: 7

CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).

PY: 2002

LE: Advanced

DE: RUGBY-UNION; PHYSIOLOGY-; MATCH-ANALYSIS; COMPARATIVE-STUDY
SH: (574127) RUGBY-UNION PHYSIOLOGY
ITSH: (574127) RUGBY-UNION FISIOLOGIA

Record 75 of 281 - SPORT Discus

TI: Differences between winning and losing basketball teams in playing efficiency

AU: Dezman,-B; Erculj,-F; Vuckovic,-G
SO: Acta-Kinesiologiae-Universitatis-Tartuensis-(Tartu) 7(Suppl), 2002, 71-74, Total No. of Pages: 4
CN: International Council of Physical Activity and Fitness Research. Symposium (23rd: 2002: Tartu, Estonia).
PY: 2002
LE: Intermediate
DE: BASKETBALL-; MATCH-ANALYSIS; SKILL-; EFFICIENCY-; ELITE-ATHLETE; MAN-; JUNIOR-; EUROPEAN-CHAMPIONSHIP
SH: (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: Examined the playing efficiency of winning and losing teams at the 19th European Championships for junior men held in Zadar, Croatia, July 14-23, 2000. Collective play in offence, offensive play in defence and efficient tactics inside the zone, was the key to victory at the European Championships.
ITSH: (546192) PALLACANESTRO TECNICO
CL: QP302 P4 #260
SX: This document is available via SIRCExpress Order Number S-849885, https://secure.sportquest.com/su.cfm?articleno=S-849885&title=S-849885

Record 76 of 281 - SPORT Discus

TI: Status quo and existing problems of men's horse vaulting in China

AU: Ding,-L; Yang,-X
SO: Journal-of-Shanghai-Physical-Education-Institute-(Shanghai) 22(1), 1998, 75-79, Total No. of Pages: 5
PY: 1998
LE: Advanced
DE: GYMNASTICS-; LONG-HORSE; MAN-; TECHNIQUE-; SKILL-; MATCH-ANALYSIS; VAULTING-; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (656192) GYMNASTICS-VAULTING TECHNIQUES-AND-SKILLS
AB: By observation on the field and statistics, the authors analyze the men's horse vaulting competitons in the preliminary trials of the 8th National Games. Results reveal that in the horse vaulting competitions, the competitors' movements are of high degree of difficulty. If the competitors would win, they must be good at the movements which will be evaluated ten points at least. Besides this, in the competitions, the form of movements is monotonous and most of them are in the type of cutwheel, which is not beneficial to the development of horse vaulting.
ITSH: (656192) VOLTEGGIO TECNICO
SX: This document is available via SIRCExpress Order Number 478531, https://secure.sportquest.com/su.cfm?articleno=478531&title=478531

Record 77 of 281 - SPORT Discus

TI: The structure of technical and tactical activities of water polo players in the first Yugoslav league during the game

AU: Dopsaj,-M; Matkovic,-I
PB: In Biomechanics and medicine in swimming VIII. Proceedings of the VIII International Symposium on Biomechanics and Medicine in Swimming, University of Jyvaskyla, Finland, June 28 - July 2, 1998, University of Jyvaskyla. Department of Biology of Physical Activity, p.435-438, Total No. of Pages: 4
CN: International Symposium on Biomechanics and Medicine in Swimming (8th : 1998 : Jyvaskyla, Finland)
PY: 1999

Record 78 of 281 - SPORT Discus

TI: Study on the antagonistic nature of main techniques employed in Chinese soccer legue A - from the viewpoint of time and space

AU: Du,-Z; Yang,-G; Yang,-B
SO: Sports-science-(Beijing) 17(5), 7 Sept 1997, 58-62, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: SOCCER-; MATCH-ANALYSIS; STRATEGY-; TECHNIQUE-; OFFENCE-; STATISTICS-; TIME-PERCEPTION; SPACE-PERCEPTION
SH: (576310) SOCCER TESTING-AND-EVALUATION
ITSH: (576310) CALCIO TEST
SX: This document is available via SIRCExpress Order Number   436587,
https://secure.sportquest.com/su.cfm?articleno=436587&title=436587

Record 79 of 281 - SPORT Discus

TI: Brief technical evaluation of the 27th Olympiad in Sydney

AU: Ejem,-M
SO: The-Coach-(Lausanne) (1), Apr 2001, 6-12, Total No. of Pages: 7
PY: 2001
LE: Intermediate
DE: EVALUATION-STUDY; MATCH-ANALYSIS; SKILL-; VOLLEYBALL-; OLYMPIC-GAMES,-SYDNEY-2000
SH: (588174) VOLLEYBALL SPORTING-EVENTS; (265393) OLYMPIC-GAMES-(SUMMER)-SYDNEY-2000 EVENTS
ITSH: (588174) PALLAVOLO COMPETIZIONE-SPORTIVA; (265393) GIOCHI-OLIMPICI-(ESTIVI)-SYDNEY-2000 COMPETIZIONE
CL: GV1015 #581
SX: This document is available via SIRCExpress Order Number   S-676848,
https://secure.sportquest.com/su.cfm?articleno=S-676848&title=S-676848

Record 80 of 281 - SPORT Discus

TI: Training-scientific analysis of individual adjustment reactions to training loads

AU: Ferger,-K
SO: Leipziger-Sportwissenschaftliche-Beitraege-(Sankt-Augustin) 40(1), 1999, 84-99, Total No. of Pages: 16
PY: 1999
LE: Advanced
DE: TEAM-SPORT; TRAINING-; CORRELATION-; ACHIEVEMENT-; SKILL-; INDIVIDUAL-DEVELOPMENT; TIME-FACTOR; LONGITUDINAL-STUDY; MATCH-ANALYSIS; CINEMATOGRAPHY-; WOMAN-
SH: (540312) TEAM-SPORTS TRAINING-AND-CONDITIONING; (902775) TRAINING-AND-CONDITIONING-TRAINING-THEORY

AB: The present study is an approach to evaluate performance parameters statistically. For this, performance and training parameters were assessed longitudinally (training variables daily, performance variables weekly) and analyzed using time series analyzing method (SPSS software package). The main emphasis was put on the evaluation of

correlation effects between assessed training parameters and the chronologically delay of individual performance. This method offers a way how to control training individually, based on video recorded game analysis and categorized training protocols.
ITSH: (540312) SPORT-DI-SQUADRA ALLENAMENTO-E-CONDIZIONAMENTO; (902775) ALLENAMENTO-TEORIA-DELL'ALLENAMENTO
CL: RC1200 #1381
SX: This document is available via SIRCExpress Order Number S-665760, https://secure.sportquest.com/su.cfm?articleno=S-665760&title=S-665760

TI: Are there statistically crucial tactical moments during squash matchplay?

AU: Flynn,-R
SO: Australian-squash-coach-(Melbourne,-Aust.) 5(1), Spring 1998, 18-21
PY: 1998
LE: Advanced
DE: SQUASH-RACQUETS; STRATEGY-; STATISTICS-; EVALUATION-; MATCH-ANALYSIS
SH: (704180) SQUASH-RACQUETS STRATEGY
ITSH: (704180) SQUASH TATTICA

TI: A seven-state Markov process for modelling Australian rules football

AU: Forbes,-D; Clarke,-S-R
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.148-158, Total No. of Pages: 11
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; STATISTICS-; MATHEMATICAL-MODEL; MATCH-ANALYSIS
SH: (542110) AUSTRALIAN-FOOTBALL MATHEMATICS
AB: The official Australian Football League data as collected by Champion Data for the 185 matches played in season 2003 has been used to develop a seven-state Markov process for modelling Australian Rules football matches. Transition probabilities for each match have been derived and the resulting matrix of probabilities powered up to ascertain the steady state distribution for each match. Expected totals for each state have been deduced using these distributions and compared back to the observed totals to ascertain the appropriateness of such a model.
ITSH: (542110) FOOTBALL-AUSTRALIANO MATEMATICA

TI: Video analysis of muscle motion

AU: Foster,-Boyd
SO: Strategies-(Reston,-Va.) 17(4), Mar/Apr 2004, 11-12, Total No. of Pages: 2
PY: 2004
LE: Intermediate
DE: MUSCLE-; BIOMECHANICS-; MOVEMENT-; ANATOMY-; KINESIOLOGY-; VIDEOTAPING-; EVALUATION-; PHYSICAL-EDUCATION; TEACHING-AID
SH: (914630) PHYSICAL-EDUCATION-TEACHING-METHODS; (944800) KINESIOLOGY-TEACHING-METHODS
AB: Provides tips for school and university teachers on using video analysis of muscle biomechanics and movement in order to facilitate learning in anatomy and kinesiology.
ITSH: (914630) EDUCAZIONE-FISICA-METODI-D'ALLENAMENTO; (944800) CINESIOLOGIA-METODI-DI-INSEGNAMENTO
CL: GV201 #4560

TI: Load organisation in youth table tennis

AU: Friedrich,-W; Moeller,-H; Boesel,-J
SO: Leistungssport-(Muenster) 30(6), Nov 2000, 36-38, Total No. of Pages: 3
PY: 2000
LE: Advanced
DE: TABLE-TENNIS; MATCH-ANALYSIS; HEART-RATE; LACTATE-; TRAINING-LOAD; TRAINING-; SPECIFICITY-OF-TRAINING; AGE-FACTOR; COMPARATIVE-STUDY; ADULT-; ADOLESCENT-; BOY-
SH: (706312) TABLE-TENNIS TRAINING-AND-CONDITIONING; (706310) TABLE-TENNIS TESTING-AND-EVALUATION
AB: In a lot of textbooks of training theory it is postulated that children's and youths' training must not be a kind of reduced adult training. In this article it is examined whether this applies to the load organisation in table tennis, too. To identify the area of load which is typical of competitive table tennis, the load structures of twelve young table tennis players belonging to a special squad of the federation were analysed. From the results of this analysis concrete recommendations for the practical organisation of training are derived.
ITSH: (706312) TENNIS-TAVOLO ALLENAMENTO-E-CONDIZIONAMENTO; (706310) TENNIS-TAVOLO TEST
CL: GV701.P4 #420
SX:　　　This document is available via SIRCExpress Order Number S-666422, https://secure.sportquest.com/su.cfm?articleno=S-666422&title=S-666422

TI: Key performances indicators: a useful coaching tool

AU: Friend,-A
PB: In, Rugby research : a selection of level 3 coaching and refereeing papers, Sydney, NSW, Australian Rugby Union, 1998, p.5-10
PY: 1998
LE: Advanced
DE: RUGBY-UNION; EVALUATION-; MATCH-ANALYSIS; COACHING-
SH: (574310) RUGBY-UNION TESTING-AND-EVALUATION; (574045) RUGBY-UNION COACHING
ITSH: (574310) RUGBY-UNION TEST; (574045) RUGBY-UNION ALLENAMENTO

TI: Attack efficacy profile in top level soccer teams

AU: Garganta,-J; Maia,-J; Marques,-A
PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.537, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs537b.htm
CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)
PY: 2000
LE: Advanced
DE: SOCCER-; MATCH-ANALYSIS; STRATEGY-; OFFENCE-
SH: (576189) SOCCER STRATEGY-OFFENSIVE
ITSH: (576189) CALCIO TATTICA-ATTACCO

In Soccer, tactical dimension seems to influence significantly team and individual players performance. Our study focus on the analysis of team offensive tactical organization, considering three latent variables in interaction and covariation: time, space and task. We analysed 497

offensive sequences, played by six international top level teams. Statistical procedures consist of discriminant analysis, with and without stepwise procedure, logistic regression and cluster analysis. We conclude that the great variability expressed on the behaviour of the players is the main point. Notwithstanding, it is possible to perceive some regularities, illustrated by the way some variables are expressed and group themselves for interaction. The results of our study allow the following conclusions: (1) the variability of the offensive actions is a factor which is associated with the efficacy; to a greater variability corresponds a bigger efficacy; (2) the lane-, type of pass-, and tempo variations are associated with the offensive efficacy; (3) the interception is the way of ball recovering that offers more advantages to reach offensive efficacy; (4) the reduced time of attack, in opposition to the conclusions of other studies, shall not be understood as a factor which comes in association with a bigger offensive efficacy of the teams.

So, the efficacy of teams seems to depend mainly on the capability to control the game, through variations in ball circulation, changes of tempo and type of pass, in order to create surprise and to promote unbalanced actions in the opposite team

Record 87 of 281 - SPORT Discus

TI: The effect of changing the rules on score fluctuation and match duration in the FIVB women's beach volleyball

AU: Giatsis,-G
SO: International-journal-of-performance-analysis-in-sport-(Cardiff) 3(1), Apr 2003, 57-64, Total No. of Pages: 8
PY: 2003
LE: Advanced
DE: BEACH-VOLLEYBALL; WOMAN-; SCORING-; RULE-; MATCH-ANALYSIS; FEDERATION-INTERNATIONALE-DE-VOLLEYBALL; WORLD-CHAMPIONSHIP; ANALYSIS-OF-VARIANCE; COMPARATIVE-STUDY
SH: (589159) BEACH-VOLLEYBALL RULES-AND-REGULATIONS; (589310) BEACH-VOLLEYBALL TESTING-AND-EVALUATION
ITSH: (589159) VOLLEYBALL-DELLA-SPIAGGIA REGOLA; (589310) VOLLEYBALL-DELLA-SPIAGGIA TEST

Record 88 of 281 - SPORT Discus

TI: Effect of push frequency on the economy of wheelchair racers

(Effet de la frequence de propulsion sur l' economie de l' effort chez des coureurs en fauteuil roulant.)
AU: Goosey,-V-L; Campbell,-I-G; Fowler,-N-E
SO: Medicine-and-science-in-sports-and-exercise-(Hagerstown,-Md.) 32(1), Jan 2000, 174-181, Total No. of Pages: 8
PY: 2000
LE: Advanced
DE: OXYGEN-CONSUMPTION; HEART-RATE; LACTATE-; MAN-; WHEELCHAIR-ERGOMETRY; WHEELCHAIR-RACING; PROPULSION-
SH: (906250) DISABLED-WHEELCHAIR-SPORTS; (980001) PHYSIOLOGY-ENERGY-METABOLISM
AB: The aim of the study was to examine the effect of varying push frequency on pushing economy (oxygen uptake at a given speed). Eight male wheelchair racers completed a series of exercise bouts on a wheelchair ergometer (Bromking Turbo Trainer, Bromakin, UK) at 6.58 m.s-1. Initially, subjects self-selected their freely chosen push frequency (FCF); this was followed by 4 random trials pushing at 60, 80, 120, and 140 % of this FCF. Steady state VO2 was determined using Douglas bags, and heart rate was recorded by telemetry. After each condition, a small capillary blood sample was obtained and analyzed for blood lactate concentration (Bla) and a rating of perceived exertion (RPE) was recorded. At 6.58 m.s-1 oxygen uptake, RPE, and gross mechanical efficiency were nonlinearly related to push frequency. Analysis of variance showed a significant effect (P M 0.05) of cycle frequency on VO2. VO2 was 11 % higher at the 140 % FCF compared with the 100 % FCF condition Changes in push frequency had little effect on HR although Bla increased linearly and was higher at the 140 % FCF condition compared with 60 % FCF (P < 0.05). A two-dimensional sagittal plane video analysis showed large interindividual differences in propulsion style. Both cycle time and the propulsion phase (%) decreased as the push frequency increased. The start angle and end angle of hand contact were similar for

conditions, whereas the range of trunk motion decreased with push frequency (P < 0.05). The results of this study showed that the push frequency had an effect on pushing economy, and that the athletes' FCF was the most economical.
ITSH: (906250) DISABILI-SPORT-SU-SEDIA-A-ROTELLE; (980001) FISIOLOGIA-METABOLISMO-ENERGETICO
CL: RC1200 #820
SX: This document is available via SIRCExpress Order Number S-163204, https://secure.sportquest.com/su.cfm?articleno=S-163204&title=S-163204

Record 89 of 281 - SPORT Discus

TI: A kinematic analysis of wheelchair propulsion techniques in senior male, senior female, and junior male athletes

(Analyse cinematique des techniques de propulsion en fauteuil roulant chez des seniors hommes et femmes et des athletes masculins juniors.)
AU: Goosey,-V-L; Fowler,-N-E; Campbell,-I-G
SO: Adapted-physical-activity-quarterly-(Champaign,-Ill.) 14(2), Apr 1997, 156-165, Total No. of Pages: 10
PY: 1997
LE: Advanced
DE: 800-M.; MIDDLE-DISTANCE-RUNNING; PROPULSION-; KINEMATICS-; WHEELCHAIR-RACING; ELITE-ATHLETE; MAN-; WOMAN-; PARAPLEGIA-; JUNIOR-; NATIONAL-CHAMPIONSHIP
SH: (736054) MIDDLE-DISTANCE-AND-L DISABLED; (906063) DISABLED-BIOMECHANICS; (906250) DISABLED-WHEELCHAIR-SPORTS
AB: The aim of the study was to examine and compare the propulsion techniques of senior male, senior female, and junior male athletes and to determine the relationship between the kinematic variables and performance. A two-dimensional video analysis was performed on the 800 m finals (n = 23) at the 1994 British Wheelchair National Track Championships. From this, the angle of lean, elbow angle, and the cycle dynamics were determined. The senior male athletes achieved a faster maximum velocity (7.3 plus/minus 0.3 m.s-1) than that achieved by the senior female (5.9 plus/minus 1.0 m.s-1) and junior male athletes (6.0 plus/minus 1.0 m.s-1), resulting in a greater distance covered during each push cycle. The kinematic analysis showed that the junior athletes adopted a 5 degree more upright position and spent less time in contact with the hand-rim (25 percent) than the senior athletes. A moderate correlation was found between cycle distance and performance time (r = -0.68; p is less than 0.01). In conclusion, this study suggests that there are kinematic differences between senior male, senior female, and junior male wheelchair athletes.
ITSH: (736054) CORSA-CORSA-DI-FONDO-E-MEZZOFONDO DISABILE; (906063) DISABILI-BIOMECCANICA; (906250) DISABILI-SPORT-SU-SEDIA-A-ROTELLE
CL: GV201 #260
SX: This document is available via SIRCExpress Order Number 415243, https://secure.sportquest.com/su.cfm?articleno=415243&title=415243

Record 90 of 281 - SPORT Discus

TI: Effects of football collars on cervical hyperextension and lateral flexion

AU: Gorden,-J-A; Straub,-S-J; Swanik,-C-B; Swanik,-K-A
SO: Journal-of-athletic-training-(Dallas,-Tex.) 38(3), July/Sept 2003, 209-215, Total No. of Pages: 7
PY: 2003
LE: Advanced
DE: FOOTBALL-; CERVICAL-VERTEBRAE; BRACHIAL-PLEXUS; INJURY-; PARESTHESIA-; PREVENTION-; PROTECTIVE-DEVICE; COLLAR-
SH: (560093) FOOTBALL INJURIES-AND-ACCIDENTS; (560144) FOOTBALL PROTECTIVE-DEVICES; (960300) INJURIES-AND-ACCIDENTS-PROTECTIVE-DEVICES
AB: Objectives: to evaluate the effectiveness of 3 football collars in reducing cervical range of motion. Design and setting: a repeated-measures design in a controlled laboratory setting. Subjects: fifteen male National Collegiate Athletic Association Division I varsity football athletes. Measurements: cervical hyperextension and lateral flexion were measured with video analysis. Subjects underwent 5 testing conditions: standard football helmet, standard helmet and shoulder pads, and standard pads with the addition of the Cowboy Collar, A-Force Neck Collar, or a foam neck roll. Subjects performed motions both actively and passively. Results: all 3 collars reduced hyperextension when compared with the helmet and shoulder pads alone (P < .05); in addition, the Cowboy Collar was superior to the foam neck roll (P < .05) in

reducing hyperextension. No collar reduced passive lateral flexion when compared with the helmet and shoulder pads, but the foam neck roll permitted significantly less active lateral flexion (P < .01) than the other 3 brace conditions. Conclusions: in a laboratory setting, cervical hyperextension can be controlled through the use of various cervical collars. Cervical lateral flexion (a more common cause of burners in a scholastic population) cannot be controlled with any of the cervical collars tested. Moreover, foam collars may impede active lateral flexion while not providing additional protection when loaded. These results are limited in that they were produced in a controlled situation as opposed to active football play.
ITSH: (560093) FOOTBALL-AMERICANO INFORTUNI-E-INCIDENTI; (560144) FOOTBALL-AMERICANO ATTREZZATURA-PROTETTIVA; (960300) INFORTUNI-E-INCIDENTI-ATTREZZATURA-PROTETTIVA
CL: RC1200 #161
SX: This document is available via SIRCExpress Order Number S-921222, https://secure.sportquest.com/su.cfm?articleno=S-921222&title=S-921222

Record 91 of 281 - SPORT Discus

TI: Pronation in der Sportschuhforschung
   (La pronation en recherche sur les chaussures de sport.)

TI: Pronation in sport shoe research

AU: Grau,-S; Baur,-H; Horstmann,-T
SO: Deutsche-Zeitschrift-fuer-Sportmedizin-(Cologne) 54(1), Jan 2003, 17-24, Total No. of Pages: 8
URL: http://www.zeitschrift-sportmedizin.de/images/heft0103/a03_01_03.pdf
PY: 2003
LE: Intermediate
DE: SPORT-; SHOES-; RESEARCH-; REVIEW-; PRONATION-; FOOT-
SH: (905340) CLOTHING-SHOES; (946600) BIOMECHANICS-RESEARCH
AB: Sport shoe research has been of great interest in practical sports and science for 20 years. The main goal of the scientific studies was to gain knowledge about changes in the construction and structure of sport shoes to prevent sports specific injuries and complaints. From the beginning, the prevention of overpronation was the most important area to look at, because the etiology of different running injuries was assumed to be related. It could be shown that in the past several quantities were used in video analysis, different shoe designs were tested and "loads" were determined but no clear relationship towards pronation was detected. Reasons might be the purely mechanical description of the pronation movement, since neuromuscular regulation processes were not measured and analyzed. Furthermore, the measurement method itself (video analysis) could be a reason, as the validity (2-D and 3-D measurements) and the reliability (2-D measurements) of the results have to be interpreted critically. Additionally, the actual relationship between quantities and injuries or complaints was studied ineffectively, as the typical studies were designed and measured with healthy subjects. Pathological patterns as well as recommendations in the prevention of injuries couldn't be defined upon this basis. Future research shall emphasize the development of alternative measurement methods (pressure distribution, force) and quantities to characterize the pronation movement, as well as on the neuromuscular aspects of movement (with electromyography). Finally, patients have to be integrated into the study designs. In daily work, knowledge about pronation suggests that rearfoot movement has to be considered individually. Thus, correction of "excessive" pronation movement with specific shoe features is not of desire in any case.
ITSH: (905340) VESTIARIO-E-CALZATURE-SCARPE; (946600) BIOMECCANICA-RICERCA
CL: RC1200 #422
SX: This document is available via SIRCExpress Order Number S-870131, https://secure.sportquest.com/su.cfm?articleno=S-870131&title=S-870131

Record 92 of 281 - SPORT Discus

TI: Dynamic-system analysis of opponent relationships in collective actions in soccer

   (Analyse du systeme dynamique des relations entre les adversaires lors des actions en football.)
AU: Grehaigne,-J-F; Bouthier,-D; David,-B
SO: Journal-of-sports-sciences-(London) 15(2), Apr 1997, 137-149, Total No. of Pages: 13
PY: 1997
LE: Advanced
DE: SOCCER-; DECISION-MAKING; SKILL-; MATCH-ANALYSIS; MOVEMENT-; TRANSITION-; SHOOTING-
SH: (576118) SOCCER PERCEPTUAL-MOTOR-PROCESSES; (576168) SOCCER SOCIAL-PSYCHOLOGY

AB: The aim of this study was to examine the contribution of the systemic approach to the analysis of play in team sports. We first focus on the theory of dynamical systems and consider the interactions between the main variables of the different components of systems and subsystems in soccer. In team sports, these variables represent fluctuating conditions, which momentarily constrain the organization of action for the players. Thus changes in the momentary configuration of the game have to be examined in the light of precious configurations, the outline of the defensive strategy and the tactical choices involved. To study this problem, we analyse the antecedents of goals in soccer. A procedure is proposed which analyses transitions between configurations of play, thus allowing time to be taken into consideration when studying the evolution of a match. To illustrate the use and benefit of the analytic procedure, two goals are described in terms of dynamic configurations of play and opportunity of choices made by attackers.
ITSH: (576118) CALCIO ABILITA-MOTORIA; (576168) CALCIO PSICOLOGIA -SOCIALE
CL: RC1200 #700
SX: This   document   is   available   via   SIRCExpress   Order   Number   416101, https://secure.sportquest.com/su.cfm?articleno=416101&title=416101

Record 93 of 281 - SPORT Discus

TI: Case report: reduction of low back pain in a professional golfer

(Etude d' un cas: traitement d' une lombalgie chez un golfeur professionnel.)
AU: Grimshaw,-P-N; Burden,-A-M
SO: Medicine-and-science-in-sports-and-exercise-(Hagerstown,-Md.) 32(10), Oct 2000, 1667-1673, Total No. of Pages: 7
PY: 2000
LE: Advanced
DE: CASE-REPORT; BACK-; PAIN-; GOLF-; KINEMATICS-; ELECTROMYOGRAPHY-; REHABILITATION-; INJURY-; MAN-; YOUNG-ADULT; LOW-BACK-PAIN
SH: (532093) GOLF INJURIES-AND-ACCIDENTS; (532027) GOLF BIOMECHANICS; (958275) INJURIES-AND-ACCIDENTS-BACK-PAIN; (960325) INJURIES-AND-ACCIDENTS-REHABILITATION
AB: Previous research agrees that the majority of injuries that affect male golfers are located in the lower back and that they are related to improper swing mechanics and/or the repetitive nature of the swing. This study describes the trunk motion and paraspinal muscle activity during the swing of a golfer with related low back pain (LBP) and assesses the effect of a 3-month period of muscle conditioning and coaching on these variables. Motion of the trunk was measured using three-dimensional video analysis and electormyograms (EMGs) were recorded from the same six sites of the erector spinae at the start and end of the 3-month period. At the end of the period, the golfer was able to play and practice without LBP. Coaching resulted in an increase in the range of hip turn and a decrease in the amount of shoulder turn, which occurred during the swing. In addition, a reduction in the amount of trunk flexion/lateral flexion during the downswing occurred in conjunction with less activity in the less erector spinae. These changes may serve to reduce the torsional and compressive loads acting on the thoracic and lumbar spine, which in turn may have contributed to the cessation of the LBP and would reduce the risk of reoccurrence in the future. In conclusion, further research with more subjects would now be warranted in order to test the findings of this program for the prevention of low back in golfers as piloted in this case report.
ITSH: (532093) GOLF INFORTUNI-E-INCIDENTI; (532027) GOLF BIOMECANICA; (958275) INFORTUNI-E-INCIDENTI-DOLORI-ALLA-SCHIENA; (960325) INFORTUNI-E-INCIDENTI-RIABILITAZIONE
CL: RC1200 #820
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-663444, https://secure.sportquest.com/su.cfm?articleno=S-663444&title=S-663444

Record 94 of 281 - SPORT Discus

TI: The efficacy of video feedback for learning the golf swing

(Efficacite du feedback video pour l' apprentissage du swing.)
AU: Guadagnoli,-M; Holcomb,-W; Davis,-M
SO: Journal-of-sports-sciences-(London) 20(8), Aug 2002, 615-622, Total No. of Pages: 8
PY: 2002
LE: Advanced
DE: GOLF-; SWING-; VISUAL-FEEDBACK; VIDEOTAPE-; LEARNING-; COMPARATIVE-STUDY

SH: (532147) GOLF PSYCHOLOGY; (532298) GOLF TECHNIQUES-AND-SKILLS-SWING; (532190) GOLF TEACHING

AB: This study was designed to examine the efficacy of video instruction relative to that of verbal and self-guided instruction. Before training, 30 golfers were assigned at random to one of three groups: video, verbal or self guided instruction. Video instruction was defined as a practice session in which the teacher was aided by the use of video. Verbal instruction was defined as practising with the teacher providing verbal feedback. Self-guided practice was defined as practising without the aid of a teacher. The participants had a pre-test, four 90 min practice sessions, an immediate post-test and a 2 week delayed post-test. During the pre-test and post-tests, all participants were required to strike 15 golf balls, with a 7-iron, from an artificial turf mat for distance and accuracy. The results showed that all groups were equal on the pre-test. On the first post-test, the two instruction groups performed worse than the self-guided group. However, on the second post-test, the two instruction groups performed better than the self-guided group, with the video group performing best. We interpret these results to mean that video analysis is an effective means of practice, but that the positive effects may take some time to develop.

ITSH: (532147) GOLF PSICOLOGIA; (532298) GOLF TECNICO-OSCILLAZIONE; (532190) GOLF INSEGNAMENTO

CL: RC1200 #700

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TI: Do human movement scientists obey the basic tenets of scientific inquiry?

(Les chercheurs en science de la motricite humaine respectent-ils les principes de base de l' investigation scientifique ?)

AU: Hale,-T

SO: Quest-(Champaign,-Ill.) 53(2), May 2001, 202-215, Total No. of Pages: 14

PY: 2001

LE: Advanced

DE: SPORTS-SCIENCE; RESEARCH-; METHOD-; SPORTS-MEDICINE

SH: (981550) PHYSIOLOGY-EXERCISE-RESEARCH-METHODS; (952250) MEDICINE-RESEARCH

AB: The nature of scientific inquiry into human movement has received scant consideration. However, an Editorial in Medicine and Science in Sports and Exercise (Raven & Squires, 1989) posed the question, "What is Science?" and asked whether the scientific research reports offered for inclusion in the journal actually obeyed Karl Popper's (1972a) basic tenets of scientific inquiry. This essay analyzes selected examples of research activity in notational analysis (including match analysis), sport psychology, and exercise physiology and argues that there is a prima facie case for suggesting that not all human movement scientists follow Popper's criteria of scientific method.

ITSH: (981550) FISIOLOGIA-DELL'ESERCIZIO-RICERCA-METODO; (952250) MEDICINA-RICERCA

CL: GV201 #3480

SX: This document is available via SIRCExpress Order Number S-779925, https://secure.sportquest.com/su.cfm?articleno=S-779925&title=S-779925

TI: Using performance analysis technology to evaluate the instructional process in sport

AU: Hammond,-J

PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.172-181, Total No. of Pages: 10

CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)

PY: 2004

LE: Advanced

DE: SOCCER-; SWIMMING-; TEACHER-; EVALUATION-; FEEDBACK-; VIDEOTAPING-

SH: (902640) COACHING-TEACHING-METHODS

AB: This paper examines two case studies in sport. Firstly, in the teaching of swimming, comparisons are made between instructors' perceived importance for facets of swimming teaching and time allocated during a lesson. Secondly, two soccer coaching accreditation courses are analysed, to provide a comparison of the aims of the instructor coach and

events taking place during the course itself. Each study employed computer and video analysis in combination with other approaches, as part of an holistic approach to evaluation. The studies demonstrated that performance analysis techniques, normally employed for the enhancement of athlete performance, can be a useful tool in assessing instructional processes in sport. Additionally, in the conference presentation itself there will be a further description of the performance analysis tools.
ITSH: (902640) ALLENAMENTO-METODI-D'ALLENAMENTO

Record 97 of 281 - SPORT Discus

TI: Die Qualitative Spielbeobachtung: eine Beobachtungsvariante zur Trainings- und Wettkampfsteuerung im Spitzensport
    (L'observation qualitative des jeux: une variante d' observation pour la direction de la competition et de l' entrainement dans le sport de haut niveau.)

TI: Qualitative game observation: an observation method for training and competition control in top-level sports

AU: Hansen,-G; Lames,-M
SO: Leistungssport-(Muenster) 31(1), Jan 2001, 61;63-64;66-70, Total No. of Pages: 8
PY: 2001
LE: Advanced
DE: TRAINING-; CORRELATION-; COMPETITION-; STRATEGY-; EVALUATION-STUDY; MATCH-ANALYSIS; METHOD-; VIDEOTAPING-; OBSERVATION-; THEORETICAL-MODEL; OLYMPIC-GAMES,-SYDNEY-2000; BEACH-VOLLEYBALL; MAN-; FEDERAL-REPUBLIC-OF-GERMANY
SH: (589310) BEACH-VOLLEYBALL TESTING-AND-EVALUATION; (589186) BEACH-VOLLEYBALL STRATEGY-DOUBLES; (265410) OLYMPIC-GAMES-(SUMMER)-SYDNEY-2000 FEDERAL-REPUBLIC-OF-GERMANY
ITSH: (589310) VOLLEYBALL-DELLA-SPIAGGIA TEST; (589186) VOLLEYBALL-DELLA-SPIAGGIA TATTICA-DOPPIO; (265410) GIOCHI-OLIMPICI-(ESTIVI)-SYDNEY-2000 REPUBBLICA-FEDERALE-TEDESCA
CL: GV701.P4 #420
SX: This document is available via SIRCExpress Order Number S-670504, https://secure.sportquest.com/su.cfm?articleno=S-670504&title=S-670504

Record 98 of 281 - SPORT Discus

TI: An analysis of movement patterns and physiological strain in relation to optimal positioning of association football referees
AU: Harley,-R-A; Tozer,-K; Doust,-J
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.137-143, Total No. of Pages: 7
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: SOCCER-; REFEREE-; MATCH-ANALYSIS; STATISTICS-; MOVEMENT-; PHYSICAL-FITNESS
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576117) SOCCER OFFICIATING
ITSH: (576310) CALCIO TEST; (576117) CALCIO ARBITRAGGIO

Record 99 of 281 - SPORT Discus

TI: L' analisi dell'allenamento e della gara nel judo

    (The analysis of training and competition in judo.)
AU: Heinisch,-H-D
SO: SDS,-Rivista-di-cultura-sportiva-(Roma) 16(37), Jan/Mar 1997, 53-62, Total No. of Pages: 10
PY: 1997
LE: Intermediate
DE: JUDO-; MATCH-ANALYSIS; TRAINING-; EVALUATION-; OBSERVATION-
SH: (669312) JUDO TRAINING-AND-CONDITIONING
AB: After an introduction on the tasks performed by the Institute for Applied Training Science in Leipzig within the framework of its system of scientific support to the training process, this paper describes the principal measures referring to judo in this system, and gives some examples of the results obtained. These measures cover the following main points, the first three of which are studied in greater depth: functional evaluation, monitoring and direction of training;

observation and analysis oh athlete's competition work; the analysis of the adversary; and the programming and planning of training. With regard to functional evaluation the paper illustrates some of the tests carried out, accompanying them with examples and interpretation of the results obtained. It then describes the system of observation and analysis of the judo competition and the dynamics of the development of competition behaviour in international level athletes; and the trend followed by changes in performance structure in judo, above all in the technical-tactical sphere. By illustrating examples of the results obtained (some of which relate to Italy), the paper highlights the way in which, on the basis of this analysis, current and future performance levels in judo can be formulated, and conclusions drawn for the training implications.

ITDE: judo-; analisi-della-gara; allenamento-; osservazione-; valutazione-; fattore-di-prestazione

ITAB: Dopo un'introduzione sui compiti del sistema di assistenza scientifica al processo di allenamento svolti dall'Istituto per la scienza applicata dell'allenamento di Lipsia vengono esposti i contenuti dei principali approcci di tale sistema nel judo, accompagnati da alcuni esempi dei risultati ottenuti. Tali contenuti riguardano principalmente questi punti, dei quali vengono approfonditi i primi tre: la valutazione funzionale ed il controllo e la direzione dell'allenamento; l' osservazione e l' analisi dell'attivita di gara degli atleti; l' analisi dell'avversario; la programmazione e la pianificazione dell'allenamento. Per quanto riguarda la valutazione funzionale vengono illustrati alcuni dei test utilizzati, accompagnandoli con esempi dei risultati ottenuti e della loro interpretazione. Vengono poi esposti il sistema di osservazione ed analisi della competizione nel judo; la dinamica dello sviluppo del comportamento di gara di atleti di livello internazionale; le tendenze nei cambiamenti nella struttura della prestazione neljudo sopratutto in ambito tecnico - tattico. Viene messo in luce, attraverso l' illustrazione di esemplificazioni dei risultati ottenuti (alcuni dei quali riguardano l' Italia), come sulla base di queste analisi si possano ottenere enunciazioni sul livello attuale e sll'evoluzione futura delle prestazioni del judo, dalle quali si possono ricavare conclusioni per la pratica dell'allenamento.

ITSH: (669312) JUDO ALLENAMENTO-E-CONDIZIONAMENTO

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Record 100 of 281 - SPORT Discus

TI: Optimum technique for generating angular momentum in accelerated backward giant circles prior to a dismount

AU: Hiley,-M-J; Yeadon,-M-R

SO: Journal-of-applied-biomechanics-(Champaign,-Ill.) 19(2), May 2003, 119-130, Total No. of Pages: 22

PY: 2003

LE: Advanced

DE: GYMNASTICS-; BACKWARD-GIANT-SWING; TECHNIQUE-; COMPARATIVE-STUDY; HORIZONTAL-BAR; MAN-; ACCELERATION-; ANGULAR-MOMENTUM; MEASUREMENT-; DISMOUNT-; SIMULATION-; ELITE-ATHLETE

SH: (642027) GYMNASTICS-HORIZONTAL BIOMECHANICS

AB: In men's artistic gymnastics the backward giant circle on the high bar is used to produce the angular momentum that the gymnast needs for executing somersaulting dismounts. Dismounts in which the gymnast performs two somersaults in the layout (straight body) position require the greatest angular momentum. However, it appears there are two distinct techniques that elite gymnasts use when performing backward giant circles prior to a double layout somersault dismount. The "traditional" technique has been superseded by the "scooped" technique which is now used by the majority of elite gymnasts. To determine whether the scooped technique is better at producing angular momentum, a simulation model was used to optimize the angular momentum about the mass center at release. The model was evaluated using data obtained from a force/video analysis of accelerated giant circles. The model was able to estimate the reaction forces measured by strain gauges on the bar to within 9% of the peak forces, and the body rotation angle to within 1% of total rotation. During the optimizations, the joint angle time histories of the model were manipulated in order to maximize the angular momentum about the model's mass center at release. Two optima were found which were characteristic of the two backward giant circle techniques used by elite gymnasts. The traditional technique produced more angular momentum than the scooped technique, although both were capable of producing sufficient angular momentum for a double layout somersault dismount. This suggests that the preference of elite gymnasts for the scooped technique must be based on factors other than the production of angular momentum.

ITSH: (642027) SBARRA-ORIZZONTALE BIOMECANICA

CL: QP302 P4 #21

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Record 101 of 281 - SPORT Discus

TI: An investigation of rugby test results

AU: Hoare,-R
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.192-197, Total No. of Pages: 6
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: RUGBY-UNION; MATCH-ANALYSIS; STATISTICS-; MATHEMATICAL-MODEL; TEST-MATCH
SH: (574110) RUGBY-UNION MATHEMATICS; (574305) RUGBY-UNION TECHNOLOGY - COMPUTER-APPLICATIONS
AB: Data from 18 rugby tests is analysed by various methods to illustrate the usefulness of statistical software to derive patterns even in such a small data set. Two tree based techniques (C&RT and CHAID) are demonstrated in order to encourage people to use these extremely powerful but infrequently used methods.
ITSH: (574110) RUGBY-UNION MATEMATICA; (574305) RUGBY-UNION TECNOLOGIA - APPLICAZIONI-INFORMATICHE

Record 102 of 281 - SPORT Discus

TI: Game strategy used by the world's top female squash players in international competition - a notational analysis

AU: Hong,-Y; Robinson,-P-D; Chan,-W-K
SO: Women-in-sport-and-physical-activity-journal-(Fort-Worth,-Tex.) 7(1), Spring 1998, 27-44, Total No. of Pages: 18
PY: 1998
LE: Advanced
DE: SQUASH-RACQUETS; WOMAN-; ELITE-ATHLETE; COMPETITION-; STRATEGY-
SH: (704398) SQUASH-RACQUETS WOMEN; (704180) SQUASH-RACQUETS STRATEGY
AB: The purpose of this paper was to profile game strategy used by world's top female squash players in international competitions using post-event notational analysis methods. A total of 10 matches from the Ladies Hong Kong Open 1993 and 1994 were selected for analysis. A total of 15 right-handed competitors, who were ranked in the top 15 in the world at that time, were involved in the matches. Matches were played under the International scoring system. A 3-CDD video camera, positioned behind the court, was used to record the player's performance throughout the matches. Frame-by-frame video notation was used to record the player, the kind of stroke, the position where the stroke was made, and the success or failure of that stroke. Shots were classified as "effective", "ineffective", "winning" and "losing" shots. Statistics show that the mean number of games per match was 4, rallies per game was 13.57 and shots per rally was 12.44. Of all the shots, 57.13 percent were "effective", 31.36 percent were "ineffective", 6.24 percent were "winning" and 5.27 percent were "losing" shots. Over half (62.01 percent) of all shots played were the drive, followed by drop (18.20 percent), volley (11.23 percent), boast (5.06 percent) and lob (3.50 percent). Of all shots played, 43.81 percent were in the back left court, 32.66 percent in the back right court, 13.04 percent in the front left court, and 10.49 percent in the front right court, showing that these right-handed players preferred to attack the backhand of the opponent. The drive (45.9 percent) was found to provide the greatest contribution shots to winning scores, with the next greatest being the drop (27.9 percent), then the volley (20.2), the boast (5.6 percent) and, finally, the lob (0.5 percent). Almost an equal number of cross-court shots and straight shots were played. In an average game, the winner played 50 percent more winning shots than the losing player, showing that in high level competition of female squash, the attacking shots, which produce the most winning scores, are required for success.
ITSH: (704398) SQUASH DONNE; (704180) SQUASH TATTICA
CL: GV709.P4 #20
SX: This document is available via SIRCExpress Order Number 480982, https://secure.sportquest.com/su.cfm?articleno=480982&title=480982

Record 103 of 281 - SPORT Discus

TI: Investigation into the effectiveness of proposed rules changes to the game of netball

AU: Hosking,-D; Hammond,-J; Sprinkle,-J

PB: In Australian Coaching Council Inc., 1996 National coaching and officiating conference: proceedings, Brisbane convention and Exhibition Centre, 30 November to 3 December 1996, 20-22, Australian Coaching Council Inc., p.20-22, Total No. of Pages: 3
PY: 1996
LE: Advanced
DE: NETBALL-; RULE-; MATCH-ANALYSIS; NOTATION-; RESEARCH-
SH: (572159) NETBALL RULES-AND-REGULATIONS
AB: In January 1996, Netball New Zealand Inc outlined a list of proposed rules changes which they have been trialing. Eight main aims were identified along with a series of corresponding rule changes which were to achieve these aims. To date, trials on such rules have provided little in relation to strong quantifiable results with no formal or scientific investifations conducted to support or oppose the effectiveness of such proposals. As a consequence of this, a study investigating the effectiveness of these proposed rules changes was set up at the University of New England.
ITSH: (572159) NETBALL REGOLA

Record 104 of 281 - SPORT Discus

TI: The effect of wet suit use by triathletes: an analysis of the different phases of arm movement

AU: Hue,-O; Benavente,-H; Chollet,-D
SO: Journal-of-sports-sciences-(London) 21(12), Dec 2003, 1025-1030, Total No. of Pages: 6
PY: 2003
LE: Advanced
DE: TRIATHLON-; SWIMMING-; CRAWL-; BIOMECHANICS-; ELITE-ATHLETE; WET-SUIT
SH: (899027) TRIATHLON BIOMECHANICS; (899091) TRIATHLON HYDRODYNAMICS; (899039) TRIATHLON CLOTHING
AB: We analyzed stroke phases and arm and leg coordination during front crawl swimming with and without a wet suit. Twelve nationally and internationally ranked French male triathletes performed three swim trials in randomized order using the front crawl stroke with and without a wet suit. All triathletes swam at three different swim velocities, corresponding to the paces appropriate for the 800 m (V800), 100 m (V100) and 50 m (V50) events. The different stroke phases and arm and leg coordination were identified by video analysis. Arm coordination was quantified using a new index of coordination, which expresses the three major modalities of opposition, catch-up and superposition in swimming. At all swim velocities, no significant differences in leg movements with or without the wet suit were noted. However, the wearing of the wet suit was associated with a significantly greater stroke length at the paces appropriate for the 100 and 50 m events (.46 % and .10 % at V100 and V50, respectively; $P < 0.01$); a significantly greater stroke index at all three velocities (.18 %, .21 % and .91 % at V800, V100 and V50, respectively; $P < 0.01$); a significantly shorter pulling phase (-10.97 %; $P < 0.05$) and lower index of coordination (-21.87 %; $P < 0.01$) at the pace appropriate for the 800 m; and a significantly greater entry and catch phase (.81 %; $P < 0.05$) at the pace appropriate for the 100 m. We conclude that the wet suit amplified the coordination mode of the triathletes (i.e. catch-up coordination) without modifying stroke rate, recovery phase or leg movements.
ITSH: (899027) TRIATHLON BIOMECANICA; (899091) TRIATHLON IDRODINAMICA; (899039) TRIATHLON ABBIGLIAMENTO
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-923296, https://secure.sportquest.com/su.cfm?articleno=S-923296&title=S-923296

Record 105 of 281 - SPORT Discus

TI: Notational analysis: a mathematical perspective

AU: Hughes,-M
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.13-47, Total No. of Pages: 35
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004

LE: Advanced
DE: NOTATION-; MATCH-ANALYSIS; EVALUATION-; FEEDBACK-; MATHEMATICAL-MODEL; PERFORMANCE-PREDICTION; STATISTICS-; STATISTICAL-RELIABILITY
SH: (902565) COACHING-STATISTICS
AB: The role of feedback is central in the performance improvement process, and by inference so is the need for accuracy and precision of such feedback. The provision of this accurate and precise feedback can only be facilitated if performance and practice is subjected to a vigorous process of analysis. Recent research has reformed our ideas on reliability, performance indicators and performance profiling in notational analysis - also statistical processes have come under close scrutiny, and have generally been found wanting. These are the areas that will continue to develop to the good of the discipline and the confidence of the sports scientist, coach and athlete. If we consider the role of a performance analyst in its general sense in relation to the data the analyst is collecting, processing and analysing there are a number of mathematical skills that will be required to facilitate the steps in the processes;- i) defining process indicators, ii) establishing the reliability of the data collected, iii) ensuring that enough data have been collected to define stable performance profiles, iv) determining which are important, v) comparing sets of data, vi) modelling performances and vii) prediction. The mathematical and statistical techniques commonly used and required for the processes are discussed and evaluated in this paper.
ITSH: (902565) ALLENAMENTO-STATISTICA

Record 106 of 281 - SPORT Discus

TI: Using notational analysis to create a more exciting scoring system for squash. (Abstract)

(Utilisation d' un systeme d' analyse de match pour creer un systeme de points en squash plus enthousiasmant pour le public.) (Resume)
AU: Hughes,-M
SO: Journal-of-sports-sciences-(London) 13(5), 1995, 426, Total No. of Pages: 1
CN: International Conference on Sport, Leisure and Ergonomics (3rd : 1995 : Burton Manor College, Cheshire).
PY: 1995
LE: Advanced
DE: SQUASH-RACQUETS; SCORING-; INNOVATION-
SH: (704117) SQUASH-RACQUETS OFFICIATING
ITSH: (704117) SQUASH ARBITRAGGIO
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-919432, https://secure.sportquest.com/su.cfm?articleno=S-919432&title=S-919432

Record 107 of 281 - SPORT Discus

TI: The application of notational analysis to racket sports

AU: Hughes,-M
PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 211-220, Total No. of Pages: 10
CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).
PY: 1998
LE: Advanced
DE: RACQUET-SPORT; ROTATION-; EVALUATION-
SH: (688310) RACQUET-SPORTS TESTING-AND-EVALUATION
ITSH: (688310) SPORT-CON-LA-RACCHETTAI TEST
CL: GV990 #34134
SX: This document is available via SIRCExpress Order Number 480692, https://secure.sportquest.com/su.cfm?articleno=480692&title=480692

Record 108 of 281 - SPORT Discus

TI: Performance analysis. (Editorial)

AU: Hughes,-M-D; Bartlett,-R-M
SO: Journal-of-sports-sciences-(London) 20(10), Oct 2002, 735-737, Total No. of Pages: 3
PY: 2002
LE: Intermediate
DE: SPORT-; BIOMECHANICS-; NOTATION-
SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS
AB: Introduction to the collection of papers, written by specialists in biomechanics, notational analysis and motor control.
ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-847005, https://secure.sportquest.com/su.cfm?articleno=S-847005&title=S-847005

Record 109 of 281 - SPORT Discus

TI: Playing patterns of elite and non-elite volleyball

AU: Hughes,-M; Daniel,-R
SO: International-journal-of-performance-analysis-in-sport-(Cardiff) 3(1), Apr 2003, 50-56, Total No. of Pages: 7
PY: 2003
LE: Advanced
DE: VOLLEYBALL-; EVALUATION-; ELITE-ATHLETE; VIDEOTAPE-; TECHNIQUE-; STRATEGY-; PLAY-; PATTERN-; MATCH-ANALYSIS; COMPARATIVE-STUDY
SH: (588310) VOLLEYBALL TESTING-AND-EVALUATION; (588192) VOLLEYBALL TECHNIQUES-AND-SKILLS; (588180) VOLLEYBALL STRATEGY
ITSH: (588310) PALLAVOLO TEST; (588192) PALLAVOLO TECNICO; (588180) PALLAVOLO TATTICA

Record 110 of 281 - SPORT Discus

TI: Notational analysis of sport: systems for better coaching and performance in sport. 2nd ed

AU: Hughes,-M; Franks,-I-M
PB: London, Routledge, 2004, 320 p.
PY: 2004
LE: Intermediate
DE: SPORT-; COACHING-; SKILL-; ACHIEVEMENT-; EVALUATION-; TALENT-IDENTIFICATION; METHOD-
SH: (902600) COACHING TALENT-IDENTIFICATION; (902700) COACHING-TESTING
AB: CONTENTS: Introduction; [1] The need for feedback; [2] The nature of feedback; [3] The use of feedback-based technologies; [4] Notational analysis - a review of the literature; [5] Sports analysis; [6] How to develop a notation system; [7] Examples of notation systems; [8] The use of performance indicators in performance analysis; [9]. Analysis of notation data: reliability; [10] Establishing normative profiles in performance analysis; [11] Models of sport contests -Markov processes, dynamical systems and neural networks; [12] Measuring coaching effectiveness; [13]. From analysis to coaching; [14] References.
ITSH: (902600) ENTRENAMIENTO IDENTIFICACION-DEL-TALENTO; (902700) ALLENAMENTO-TEST

Record 111 of 281 - SPORT Discus

TI: Using computerised notational analysis to create a template for elite squash and its subsequent use in designing hand notation systems for player development

AU: Hughes,-M; Robertson,-C
PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 227-234, Total No. of Pages: 8

CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).
PY: 1998
LE: Advanced
DE: SQUASH-RACQUETS; NOTATION-; EVALUATION-; COMPUTER-; DESIGN-; ELITE-ATHLETE
SH: (704310) SQUASH-RACQUETS TESTING-AND-EVALUATION
ITSH: (704310) SQUASH TEST
CL: GV990 #34134
SX: This document is available via SIRCExpress Order Number 480694, https://secure.sportquest.com/su.cfm?articleno=480694&title=480694

TI: The Application of notational analysis to racket sports (Application de l' analyse des notes aux sports de balle)

AU: Hughes-M
SO: Science and racket sports II : proceedings of the second world congress of science and racket sports and fifth international table tennis federation sports science congress, 22-25 April 1997 / Ed. by A. Lees, M. Hughes, I. Maynard,...[et al].- Londres : Spon, 1998 ROYAUME UNI, pp 211-219, 11 p., Notes bibliogr. p 218-219
PY: 1998
LE: Advanced

TI: Using computerised notational analysis to create a template for elite squash and its subsequent use in designing hand notation systems for player development (Utilisation de l' analyse informatisee pour la creation d' un 'calibre pour le squash de haut niveau et son utilisation dans les systemes manuels de notations)

AU: Hughes-M/-Robertson-C
SO: Science and racket sports II : proceedings of the second world congress of science and racket sports and fifth international table tennis federation sports science congress, 22-25 April 1997 / Ed. by A. Lees, M. Hughes, I. Maynard,...[et al].- Londres : Spon, 1998 ROYAUME UNI, pp 227-234, 8 p., Notes bibliogr. p 234
PY: 1998
LE: Advanced

TI: Analysis of passing sequences, shots and goals in soccer

AU: Hughhes,-Mike; Franks,-Ian
SO: Journal-of-sports-sciences-(London) 23(5), May 2005, 509-514, Total No. of Pages: 6
PY: 2005
LE: Advanced
DE: EVALUATION-STUDY; MATCH-ANALYSIS; SOCCER-; ELITE-ATHLETE; SKILL-; STRATEGY-; WORLD-CUP; PASSING-; SHOOTING-
SH: (576192) SOCCER TECHNIQUES-AND-SKILLS; (576180) SOCCER STRATEGY
AB: Early research into how goals were scored in association football (Reep and Benjamin, 1968) may have shaped the tactics of British football. Most coaches have been affected, to a greater or lesser extent, by the tactics referred to as the "long-ball game" or "direct play", which was a tactic employed as a consequence of this research. Data from these studies, published in the late 1960s, have been reconfirmed by analyses of different FIFA World Cup tournaments by several different research groups. In the present study, the number of passes that led to goals scored in two FIFA World Cup finals were analyzed. The results conform to that of previous research, but when these data were normalized with

respect to the frequency of the respective lengths of passing sequences, there were more goals scored from longer passing sequences than from shorter passing sequences. Teams produced significantly more shots per possession for these longer passing sequences, but the strike ratio of goals from shots is better for "direct play" than for "possession play". Finally, an analysis of the shooting data for successful and unsuccessful teams for different lengths of passing sequences in the 1990 FIFA World Cup finals indicated that, for successful teams, longer passing sequences produced more goals per possession than shorter passing sequences. For unsuccessful teams, neither tactic had a clear advantage. It was further concluded that the original work of Reep and Benjamin (1968), although a key landmark in football analysis, led only to a partial understanding of the phenomenon that was investigated. [ABSTRACT FROM AUTHOR]
ITSH: (576192) CALCIO TECNICO; (576180) CALCIO TATTICA
CL: RC1200 #700
SX: This document is available via SIRC Document Delivery Service - Article Number S-984328, http://articles.sirc.ca/search.cfm?id=S-984328

Record 115 of 281 - SPORT Discus

TI: Extrinsic muscle activity, foot motion and ankle joint moments during the stance phase of walking

AU: Hunt,-A-E; Smith,-R-M; Torode,-M
SO: Foot-and-ankle-international-(Baltimore,-Md.) 22(1), Jan 2001, 31-41, Total No. of Pages: 11
PY: 2001
LE: Advanced
DE: KINEMATICS-; KINETICS-; ELECTROMYOGRAPHY-; WALKING-; FOOT-; ANKLE-JOINT
SH: (946300) BIOMECHANICS-GAIT
AB: This study examined stance phase foot kinematics, kinetics and electromyographic (EMG) activity of extrinsic muscles of 18 healthy males. Three-dimensional kinematic and kinetic data were obtained via video analysis of surface markers and a force plate. Ankle joint moments are described about orthogonal axes in a segmental coordinate system. Kinematic data comprise rearfoot and forefoot motion, described about axes of a joint coordinate system, and medial longitudinal arch height. Surface EMG was obtained for tibialis anterior, soleus, gastrocnemius medialis and lateralis, peroneus longus and peroneus brevis and extensor digitorum longus. It was concluded that the demands on the controlling muscles are greatest prior to foot flat and after heel rise. Tibialis anterior restrained rearfoot plantarflexion from heel contact to 10 % stance, and eversion between 10 % stance and footflat. Activity in peroneus longus was consistent with its role in causing eversion after heel contact, then as a stabiliser of the forefoot after heel rise. Activity in peroneus brevis suggested a role in restraining lateral rotation of the leg over the foot, late in stance.
ITSH: (946300) BIOMECCANICA-ANDATURA
CL: R1.P4 #41
SX: This document is available via SIRCExpress Order Number S-671033, https://secure.sportquest.com/su.cfm?articleno=S-671033&title=S-671033

Record 116 of 281 - SPORT Discus

TI: Software for analysis of quantitative and qualitative evalutation (sic) in real time in basketball

(Le software pour l' evaluation de l' analyse quantitative et qualitative en temps reel en basket-ball.)
AU: Ibanez-Godoy,-S-J; Perez-Toledano,-M-A; Macias-Garcia,-M
PB: In Sports information in the third Millennium: proceedings of the 11th IASI World Congress. Lausanne 25th-27th April 2001, Lausanne, Olympic Museum and Olympic Studies Centre, c2001, p.257-266, Total No. of Pages: 10
CN: IASI world congress (11th : 2001 : Lausanne).
PY: 2001
LE: Advanced
DE: BASKETBALL-; MATCH-ANALYSIS; COACHING-; COMPUTER-PROGRAM; DESIGN-
SH: (546045) BASKETBALL COACHING; (546305) BASKETBALL TECHNOLOGY - COMPUTER-APPLICATIONS; (546310) BASKETBALL TESTING-AND-EVALUATION
ITSH: (546045) PALLACANESTRO ALLENAMENTO; (546305) PALLACANESTRO TECNOLOGIA - APPLICAZIONI-INFORMATICHE; (546310) PALLACANESTRO TEST
CL: GV 567.5 #35352

TI: Discriminant analysis of game indicators: a study in elite basketball players. (Abstract)

The purpose of this study was to identify the discriminatory power of Basketball game performance indicators in elite Basketball players.

One hundred and nineteen elite male Basketball players who were participants in the Portuguese Professional Basketball League took part in this study. The players were separated according to specific game positions (guards, n=39; forwards, n=46; centers, n=34). The data were collected by a trained group of observers and included, for each player, quantitative information on: 1) percent of success of 2 point shots, 2) percent of success of 3 point shots number of assists, 3) percent of success of free-throw shots, 4) percent of success of fast-break, 5) number of fouls made by, 6) number of fouls made on, 7) number of defensive rebounds, 8) number of offensive rebounds, 9) number of turn-over, 10) number of steals, 11) number of assists, 12) number of blocks, 13) number of interceptions, and 14) number of minutes played.

To solve the problem of player's discrimination by game position, the statistic approach of Discriminant Analysis was used.

Two discriminant functions were found: DF1: c^2=121.037, p=0.000, Rc=0.76 and DF2: c^2=26.565, p=0.014, Rc=0.46. In the first DF, structural coefficients show the relevance of offensive rebounds, defensive rebounds and blocks.

In the second DF, major importance goes to structural coefficients related to assists and turnovers. Confusion matrix showed the following reclassification of the subjects in their original groups: Guards (87.2%), Forwards (78.2%) and Centers (55.5%).

Main conclusions: 1) there is a clear demarcation of different technical and tactical profiles that are related to specific game constraints; 2) separation of subjects per game position is a complex factor highlighting major aspects of game demands.

Moreover, this complex factor is somewhat dependent on the size of athletes

TI: Technical statistics and analysis of 2001 Chinese national men's basketball youth league (in Chaoyang district of Beijing).)

AU: Jia,-Z-Q
SO: Journal-of-Beijing-university-of-physical-education-(Beijing,-P.R.China) 25(2), 2002, 267-269, Total No. of Pages: 3
PY: 2002
LE: Advanced
DE: BASKETBALL-; TEAM-; MAN-; COMPETITION-; MATCH-ANALYSIS; TECHNIQUE-; ELITE-ATHLETE; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (546177) BASKETBALL STATISTICS-AND-RECORDS; (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: The statistical technical data of 15 basketball matches of the 2001 Chinese national men's basketball youth league (in the Chaoyang district of Beijing) were analyzed and compared, which reflect the current situation of the technique and tactics application by the men's basketball teams of the Chinese northern youth during competition. The generality and individuality of the teams were discussed for reference of studying and training. Suggestions were made on the current situation of the men's basketball representative team of Beijing University of Physical Education and measures taken for its development.
ITSH: (546177) PALLACANESTRO STATISTICA; (546192) PALLACANESTRO TECNICO

Record 119 of 281 - SPORT Discus

TI: Preliminary approach to causes of players' technical misplay in handball matches

AU: Jin,-Y
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 20(3), Sept 1997, 79-82, Total No. of Pages: 4
PY: 1997
LE: Advanced
DE: TEAM-HANDBALL; TECHNIQUE-; STRATEGY-; BEHAVIOUR-PROBLEM; MATCH-ANALYSIS
SH: (584310) TEAM-HANDBALL TESTING-AND-EVALUATION
AB: Through training practice, combining with the statistics in the 1995 National Handball Championship the causes of the players' technical misplay was analyzed. It was suggested that misplay was one of the factors that directly influenced win or loss of a match as well as technique and tactics to be brought into normal play. Therefore, to reduce misplay in a match is an important link to win a match.
ITSH: (584310) PALLAMANO-DI-SQUADRA TEST
SX: This document is available via SIRCExpress Order Number 454213, https://secure.sportquest.com/su.cfm?articleno=454213&title=454213

Record 120 of 281 - SPORT Discus

TI: differences in selected kinematic flight parameters of the most and the least successful ski jumpers of the 1996 World Cup Competition in Innsbruck

AU: Jost,-B; Vaverka,-F; Kugovnik,-O; Coh,-M
SO: Biology-of-sport-(Warsaw) 15(4), 1998, 245-251, Total No. of Pages: 7
PY: 1998
LE: Advanced
DE: SKI-JUMPING; ELITE-ATHLETE; WORLD-CUP; MOVEMENT-; TECHNIQUE-; SKILL-; SKI-FLYING; LENGTH-; SPEED-; ROTATION-; ANGULAR-MOMENTUM; MEASUREMENT-; KINEMATICS-; METHOD-; SEGMENTAL-ANALYSIS-TECHNIQUE; VIDEOCAMERA-; INSTRUMENTATION-; COMPARATIVE-STUDY
SH: (500027) SKI-JUMPING BIOMECHANICS; (500192) SKI-JUMPING TECHNIQUES-AND-SKILLS; (946400) BIOMECHANICS-KINEMATICS; (946700) BIOMECHANICS-SKILLS-ANALYSIS; (500027) SKI-JUMPING BIOMECHANICS
AB: This investigation involved a total of 85 ski-jumpers participating in the Innsbruck World Cup Competition in 1996. 50 participants were analysed in the first series and 35 - in the final series of jumps. The aim of this study was to assess the differences in selected kinematic variables between the ski-jumpers who attained the longest jumps and those less successful who performed the shortest jumps. For the comparative reasons, 10 best (B) and 10 worst (L) jumpers -

regarding the results in both series - were selected. The flight phase of the particular jump was recorded by 2 cameras, located 15 and 74 m from the take-off edge. Positions of jumpers and of skis were analysed by selecting 4 velocities and 8 angle variables. The 8-point segmental model was used for analysing the angles. Data were processed with the use of a 2D video analysis system. The B-jumpers attained significantly higher in-run velocities and vertical velocities of the flight than L-jumpers. A difference between both groups regarding their flight position has been noted only in the main flight phase (74 m). The B-jumpers were already in the progressive forward rotation at 14 m as well as in 14 m of the flight. The flight position of B-jumpers was closer to the so-called "flat V style". The magnitudes of measured variables of the flight position can be utilised as a model for practice.

ITSH: (500027) SALTO-CON-GLI-SCI BIOMECANICA; (500192) SALTO-CON-GLI-SCI TECNICO; (946400) BIOMECCANICA-CINEMATICA; (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (500027) SALTO-CON-GLI-SCI BIOMECANICA

CL: RC1200 #1780

SX: This document is available via SIRCExpress Order Number S-165604, https://secure.sportquest.com/su.cfm?articleno=S-165604&title=S-165604

Record 121 of 281 - SPORT Discus

TI: Evaluation of variables of shooting for a goal recorded during the 1997 European Basketball Championship in Barcelona

(Vrednovanje varijabli ubacivanja lopte u kos na Europskom kosarkaskom prvenstvu 1997. u Barceloni.)

(Bewertung der bei Basketballeuropameisterschaft in Barcelona 1997 verzeichneten Variablen des Schiessens aufs Ziel.)

AU: Jukic,-I; Milanovic,-D; Vuleta,-D; Bracic,-M

SO: Kinesiology-(Zagreb) 32(2), Dec 2000, 51-62, Total No. of Pages: 12

PY: 2000

LE: Advanced

DE: EVALUATION-STUDY; MATCH-ANALYSIS; BASKETBALL-; ELITE-ATHLETE; MAN-; SHOOTING-; EFFICIENCY-; SKILL-; EUROPEAN-CHAMPIONSHIP

SH: (546288) BASKETBALL TECHNIQUES-AND-SKILLS-SHOOTING

AB: The research was conducted in order to determine the size of the influence that the variables regarding throwing the ball into the basket have on the final basketball match score. For data acquisition the sample of 62 European Championship matches held in Barcelona was used. The sample of manifested variables consisted of seven standard indicators of situation-related efficiency concerning shooting and assists that were officially registered for each team. The data, gathered from the official basketball game statistics were processed by means of basic statistical procedures, while the main research problem was analysed by applying the classical algorithm of the regression analysis. The significant difference was determined between the winning and losing teams in variables of shooting and assists, the winning teams achieving the better results. The difference in the total match score averages between the winning and losing teams was 11 points. Regression analysis revealed interesting information on the relation of the predicting variables regarding ball throws and assists with the final game score in a basketball match. Multiple and partial regression coefficients suggest that the final match score could be predicted on the basis of the predicting variables. Multiple correlation of .59 is statistically significant and there is no doubt that 35 % of the variance is common to the predicting variables and to the final match score. In the partial regression coefficients three variables (SUT2NE - two-point field goal-unsuccessful, SUT3NE - three-point field goal-unsuccessful, and SLBAUS - free throws-successful) appeared to be the significant predictors. The obtained results support the tactical requirements for a high quality of the play organisation on the phase of offence, which should provide a rational selection of shootings and minimise the number of unsuccessful throws. The SLBAUS variable displays that the losing teams were repeatedly forced to commit a considerable number of personal fouls which was, from the aspect of the success criterion, i.e. the final match outcome, beneficial for the winning teams that were successful in performing free throws. This study is a continuation of the research, established long ago, on the influence of standard indicators of the situation-related efficiency on a match outcome or success in the basketball game. It opens further possibilities for enlarging the basis of knowledge concerning this important segment of exact, objective monitoring of sports games, especially basketball.

ITSH: (546288) PALLACANESTRO TECNICO-TIRO

CL: QP302 P4 #220

SX: This document is available via SIRCExpress Order Number S-673030, https://secure.sportquest.com/su.cfm?articleno=S-673030&title=S-673030

Record 122 of 281 - SPORT Discus

TI: Comparative biomechanical analysis of 110 m hurdles of Igor Kovac and Peter Nedelicky

(Primerjalna biomehanicna analiza teka na 110 m ovire Igorja Kovaca in Peter Nedelickyja.)

AU: Kampmiller,-T; Slamka,-M; Vanderka,-M
SO: Kinesiologia-Slovenica-(Ljubljana) 5(1/2), 1999, 26-30, Total No. of Pages: 5
PY: 1999
LE: Advanced
DE: HURDLE-RACE; 110-M.; COMPARATIVE-STUDY; BIOMECHANICS-; MAN-; KOVAC,-I.; NEDELICKY,-P.; KINEMATICS-
SH: (732027) HURDLE-RACE BIOMECHANICS; (946400) BIOMECHANICS-KINEMATICS
AB: The biomechanical characteristics of two athletes' technique in 100m hurdles were analyzed, trying to find the parameters leading to the difference in their running results. The measurements were performed in the final race of the IAAF-II meeting Slovnaft '97 in Bratislava. The subjects were 1.K with a personal best of 13.13 s and P.N. with 13.97 s. They were filmed with a S-VHS camera at 50 Hz on the 8th hurdle. The film was analyzed with the BAF 2D video analysis system, the time, space and velocity parameters were obtained and joint moments of the knees and hips computed. The competitors realize the support phase before and after the hurdle in different ways. The position of C.G. before the hurdle is lower for I.K., he has a longer breaking and acceleration phase. However, differences are mostly in the kinematics after the hurdle. I.K. goes to touch-down with a higher C.G. position. His elastic stiffness is more developed because of quicker deceleration of C.G. lowering during the first part of the support phase after the hurdle. Also, during take-off, the position of C.G. of I.K. is higher. This leads to I.K.'s higher velocity with shorter support and acceleration phases.
ITSH: (732027) CORSA-GARA-AD-OSTACOLI BIOMECANICA; (946400) BIOMECCANICA-CINEMATICA
CL: QP302.P4 #240
SX: This document is available via SIRCExpress Order Number S-162900, https://secure.sportquest.com/su.cfm?articleno=S-162900&title=S-162900

Record 123 of 281 - SPORT Discus

TI: Computerized video analysis system for elite coaches

AU: Katz,-L; Yeadon,-M-R; Richardson,-W-T
PB: s.l., The University of Calgary, 1991, 1 v.
PY: 1991
LE: Intermediate
DE: COACHING-; ELITE-ATHLETE; VIDEOTAPE-; EVALUATION-; TECHNIQUE-; MICROCOMPUTER-
SH: (900600) COACHING-AUDIO-VISUAL-AIDS
ITSH: (900600) ALLENAMENTO-SUSSIDI-AUDIOVISIVI
CL: GV711 #28042

Record 124 of 281 - SPORT Discus

TI: Physical demands of elite Rugby League referees: Part one - time and motion analysis

AU: Kay,-B; Gill,-N-D
SO: Journal-of-science-and-medicine-in-sport-(Belconnen,-A.C.T.) 6(3), Sept 2003, 339-342, Total No. of Pages: 4
PY: 2003
LE: Advanced
DE: RUGBY-LEAGUE; REFEREE-; MATCH-ANALYSIS; EVALUATION-
SH: (575117) RUGBY-LEAGUE OFFICIATING
AB: The purpose of the present study was to accurately and reliably analyse the nature of movement undertaken by National Rugby League (NRL) referees during matches played in the 2000 season. The movements of NRL referees (n=5) were analysed from videotape footage of ten games. The researchers assigned each movement to one of six defined categories (stationary, walking forwards, jogging forwards, sprinting, sideways, and backwards), and recorded number of repetitions, movement durations, and distances covered during each specific movement category. Distance was estimated using on-field markings as known points. Mean total distance per game was 6.7 km0.4 km (mean standard deviation), and was made up of ~940 movements per game. The data showed 87% of distance was made up of a cyclic activity comprising jogging forwards, then backwards at mean running speeds of 7.2 km.h-1 and 10.8 km.h-1

respectively (made up of 9s bursts on average, each separated by 3s breaks). However, this cyclic activity accounted for only 47% of time, as referees were stationary 41% of time. Play was continuous for 90s71s at each phase of play, and was followed by rest of 45s36s throughout matches (work to rest ratio was 2:1). These findings suggest Rugby League refereeing is a highly intermittent activity and therefore training and fitness assessments should reflect these specific demands experienced during a game.

ITSH: (575117) RUGBY-LEAGUE ARBITRAGGIO

CL: RC1200 #2600

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TI: Rennstrategien im Rudern bei den Olympischen Spielen in Sydney
(Strategies de course en aviron aux Jeux Olympiques de Sydney.)

TI: Racing strategies in rowing at the Olympic Games in Sydney

AU: Kleshnev,-V

SO: Leistungssport-(Muenster) 31(6), Nov 2001, 17-19, Total No. of Pages: 3

PY: 2001

LE: Advanced

DE: ROWING-; STRATEGY-; SPEED-; MATCH-ANALYSIS; OLYMPIC-GAMES,-SYDNEY-2000; MAN-; WOMAN-

SH: (452180) ROWING STRATEGY

AB: The four 500 m intermediate times each of all men's and women's races in all boat categories at the Olympic Games in Sydney are examined in terms of racing strategy. From the 516 racing courses 12 different strategies are identified, of which, however, only one is extremely successful. It is characteristic of this strategy that the speed during the first part of the race is not too fast although faster than the average and that during the last quarter of the race a time near the mean value is achieved.

ITSH: (452180) CANOTTAGGIO TATTICA

CL: GV701 P4 #420

SX: This document is available via SIRCExpress Order Number S-798560, https://secure.sportquest.com/su.cfm?articleno=S-798560&title=S-798560

TI: Video analysis of blows to the head and face at the 1999 World Taekwondo Championships

(Analyse video des coups portes a la tete et la figure lors du championat du monde de taekwondo de 1999.)

AU: Koh,-J-O; Watkinson,-E-J

SO: Journal-of-sports-medicine-and-physical-fitness-(Torino) 42(3), Sept 2002, 348-353, Total No. of Pages: 6

PY: 2002

LE: Advanced

DE: TAE-KWON-DO; KICKING-; PUNCHING-; HEAD-; FACE-; INJURY-; PREVENTION-; VIDEOTAPING-; ADULT-; ADOLESCENT-; ELITE-ATHLETE; RETROSPECTIVE-STUDY

SH: (682093) TAE-KWON-DO INJURIES-AND-ACCIDENTS; (959300) INJURIES-AND-ACCIDENTS-HEAD-INJURIES; (960250) INJURIES-AND-ACCIDENTS-PREVENTION

AB: Limited research has been done on head blows that may result in mild traumatic brain injury in Taekwondo. The purpose of this study was to investigate the fighting conditions under which blows to the head commonly take place, with a view to determining the typical conditions under which injury may occur. Experimental design: videotape analysis (retrospective). Setting: the semi-final and final matches (a total of 48 matches) at the 14th World Taekwondo Championships in 1999. Participants: 64 athletes (32 females and 32 males) who won elimination-round matches (out of 563 competitors), aged 15 to 38 years. Measures: frequency, mechanism of head blows, characteristics of situations leading up to and following head blows, frequency of multiple impacts. A total of 35 incidents of head blow occurred (365 blows per 1,000 athlete exposures). All of these head blows were associated with a direct head or face contact and frequently involved: a closed sparring stance, shorter athletes, axe or roundhouse type kicks, attacker's offensive kick, and head-blow-receiver's offensive action with absence of a blocking skill. To prevent possible brain injury resulting from direct head blows, updated safety education, a complete understanding of concussion for athletes, coaches, and referees, and a rule change in competition Taekwondo are recommended.

Record 127 of 281 - SPORT Discus

TI: A predicted optimal performance of the Yurchenko layout vault in women's artistic gymnastics

AB: The Yurchenko layout vault is the base vault from which more advanced forms of the Yurchenko family of vaults have evolved. The purpose of the study was to predict an individual's optimal Yurchenko layout vault by modifying selected critical mechanical variables. The gymnast's current performance characteristics were determined using the Peak-Motus video analysis system. Body segment parameters were determined using the elliptical zone mathematical modeling technique of Jensen (1978). A 5-segment computer simulation model was personalized for the gymnast comprising the hands, upper limbs, upper trunk, lower trunk, and lower limbs. Symmetry was assumed, as the motion was planar in nature. An objective function was identified which translated the subjective points-evaluation scheme of the Federation of International Gymnastics (FIG) Code of Points to an analytic expression that was mathematically tractable. The objective function was composed of performance variables that, if maximized, would result in minimal points being deducted and bonus points being allocated. A combined optimal control and optimal parameter selection approach was applied to the model to determine an optimum technique. The predicted optimal vault displayed greater post-flight amplitude and angular momentum when compared with the gymnast's best trial performance. Increased angular velocity, and consequently greater angular momentum at impact and greater shoulder flexion angle at impact with the horse, were related with this optimum technique. The impact phase therefore serves to increase the angular momentum during horse contact. Since the optimized parameters at impact with the horse were within the accepted physical capacity limits observed for the individual, the predicted vault is viable.

Record 128 of 281 - SPORT Discus

TI: Three-dimensional in vivo kinematics of the shoulder during humeral elevation

AB: Shoulder kinematics, including scapular rotation relative to the trunk and humeral rotation relative to the scapula, were examined during humeral elevation in three vertical planes via video analysis of intracortical pins. Helical axis parameters provided an easily interpretable description of shoulder motion not subject to the limitations associated with Cardan/Euler angles. Between 30 and 150 degrees of elevation in each plane, the scapula rotated almost solely about an axis perpendicular to the scapula. Additional scapular rotation appeared to support the notion that the scapula moves "toward" the plane of elevation. Humeral rotation took place mainly in the plane of the scapula independent of the plane of elevation. Many parameters of shoulder complex kinematics were quite similar across all planes of elevation, suggesting a consistent movement pattern with subtle differences associated with the plane of elevation.

ITSH: (946400) BIOMECCANICA-CINEMATICA
CL: QP302.P4 #21

TI: Physiological demands of top-class soccer refereeing in relation to physical capacity: effect of intense intermittent exercise training

(Exigences physiologiques pour des arbitres de haut niveau en football par rapport a leurs capacites physiques: effet d' un entrainement intermittent intense.)
AU: Krustrup,-P; Bangsbo,-J
SO: Journal-of-sports-sciences-(London) 19(11), Nov 2001, 881-891, Total No. of Pages: 11
PY: 2001
LE: Advanced
DE: SOCCER-; OFFICIATING-; PHYSIOLOGY-; LACTATE-; HEART-RATE; RUNNING-; TRAINING-; ENERGY-EXPENDITURE; MAN-; MATCH-ANALYSIS
SH: (576117) SOCCER OFFICIATING; (903255) OFFICIATING-PHYSIOLOGY; (980001) PHYSIOLOGY-ENERGY-METABOLISM

AB: To examine the activity profile and physiological demands of top-class soccer refereeing, we performed computerized time-motion analyses and measured the heart rate and blood lactate concentration of 27 referees during 43 competitive matches in the two top Danish leagues. To relate match performance to physical capacity and training, several physiological tests were performed before and after intermittent exercise training. Total distance covered was 10.07 0.13 km (mean sx), of which 1.67 0.08 km was high-intensity running. High-intensity running and backwards running decreased ($P < 0.05$) in the second half. Mean heart rate was 162 2 beats.min-1 (85 1 % of maximal heart rate) and the mean blood lactate concentration was 4.9 0.3 (range 1.7-14.0) mmol.1-1. The amount of high-intensity running during a match was related to the Yo-Yo intermittent recovery test ($r2 = 0.57$; $P < 0.05$) and the 12 min run ($r2 = 0.21$; $P < 0.05$). After intermittent training (n = 8), distance covered during high-intensity running was greater (2.06 0.13 vs 1.69 0.08 km; $P < 0.05$) and mean heart rate was lower (159 1 vs 164 2 beats.min-1; $P < 0.05$) than before training. The results of the present study demonstrate that: (1) top-class soccer referees have significant aerobic energy expenditure throughout a game and episodes of considerable anaerobic energy turnover; (2) the ability to perform high-intensity running is reduced towards the end of matches; (3) the Yo-Yo intermittent recovery test can be used to evaluate referees' match performance; and (4) intense intermittent exercise training improves referees' performance capacity during a game.
ITSH: (576117) CALCIO ARBITRAGGIO; (903255) ARBITRAGGIO-FISIOLOGIA; (980001) FISIOLOGIA-METABOLISMO-ENERGETICO
CL: RC1200 #700

TI: Activity profile and physiological demands of top-class soccer assistant refereeing in relation to training status

(Profil d' activite et exigences physiologiques requises lors de l' entrainement des arbitres-assistants de football de haut niveau.)
AU: Krustrup,-P; Mohr,-M; Bangsbo,-J
SO: Journal-of-sports-sciences-(London) 20(11), Nov 2002, 861-871, Total No. of Pages: 11
PY: 2002
LE: Advanced
DE: SOCCER-; REFEREE-; LACTATE-; HEART-RATE; TIME-FACTOR; MOVEMENT-; RUNNING-; TRAINING-LOAD; BODY-TEMPERATURE; MATCH-ANALYSIS
SH: (576127) SOCCER PHYSIOLOGY; (576117) SOCCER OFFICIATING; (980350) PHYSIOLOGY-ENERGY-METABOLISM-LACTATE; (979400) PHYSIOLOGY-CARDIOVASCULAR-HEMODYNAMICS; (983001) PHYSIOLOGY-MUSCLE

AB: To determine the movement patterns and physiological demands of top-class soccer assistant referees, we performed computerized time-motion analysis and measured heart rate and blood lactate concentration in 15 assistant referees during 22 competitive matches in the top Danish league. To relate match performance to the physical capability of the assistant referees, they performed a 3 X 30 m sprint protocol before and after matches and a laboratory treadmill test within 3 weeks of the games. The mean total distance covered by the top-class assistant referees was 7.28 (range 5.78-8.16) km, of which 1.15 (0.86-1.44) km was high-intensity running and 1.16 (0.12-2.34) km was sideways running. The amount of high-intensity running during a game was correlated with performance of repeated sprints ($r = 0.80$, $P < 0.05$). Mean heart rate was 137 (117-159) beats.min-1, corresponding to 73 % (60-88 %) of maximal heart rate and 65 % (53-80 %) of maximal oxygen uptake. Blood lactate concentration was 4.7 (1.6-11.0) and 4.8 (1.1-13.7) mmol.1-1 after the first and second half, respectively. Sprinting performance was poorer ($P < 0.05$) after than before the games. The peak distance to the offside line was greater ($P < 0.05$) in the second than the first half (7 1 vs 5 0 m). Our results show that: (1) top-class assistant soccer refereeing is characterized by brief intense bouts of forward and sideways running interspersed with long periods of low activity; (2) top-class soccer assistant referees have moderate aerobic energy production during games with episodes of high aerobic and anaerobic energy turnover; (3) assistant referees' performance of repeated sprints correlates with the amount of high-intensity running performed in a game; and (4) sprint performance decreases towards the end of a game, which appears to affect assistant referees' ability to keep up with play.
ITSH: (576127) CALCIO FISIOLOGIA; (576117) CALCIO ARBITRAGGIO; (980350) FISIOLOGIA-METABOLISMO-ENERGETICO-LATTATO; (979400) FISIOLOGIA-CARDIOVASCOLARE-CIRCOLAZIONE-DEL-SANGUE; (983001) FISIOLOGIA---MUSCOLO
CL: RC1200 #700

TI: Zur Bedeutung grundlegender Leistungsvoraussetzungen fuer die Wettkampfleistung der Schwimmer
      (Importance des conditions de base pour des performances de competition en natation.)

TI : About the significance of basic performance prerequisites for the competition performance in swimming.

AU: Kuechler,-J; Witt,-M
LE: Advanced
DE: SWIMMING-; SPRINT-SWIMMING; ELITE-ATHLETE; MATCH-ANALYSIS; VIDEOTAPE-; VISUAL-FEEDBACK; SKILL-; MAN-; WOMAN-
SH: (408192) SWIMMING TECHNIQUES-AND-SKILLS; (418192) SPRINT-SWIMMING TECHNIQUES-AND-SKILLS
AB: Last year the short-track swimming competitions were completely marked by the preparation for the forthcoming Olympic Games in Sydney. Numerous world records were the result. In this article the performances of selected top athletes are analysed using a computer-supported video system for partial-time measuring. The focus is on basic performance prerequisites for the competition performance.
ITSH: (408192) NUOTO TECNICO; (418192) VELOCITA-NEL-NUOTO TECNICO
CL: GV701.P4 #420

TI: Analysis of team sport game strategies: a way forward using handball. (Abstract)

AU: Kuhl,-C; Nicholson,-C-M
LE: Advanced

DE: TEAM-HANDBALL; STRATEGY-; PATTERN-; MATCH-ANALYSIS; EVALUATION-STUDY; COACH-; KNOWLEDGE-LEVEL
SH: (584180) TEAM-HANDBALL STRATEGY
ITSH: (584180) PALLAMANO-DI-SQUADRA TATTICA
CL: GV557.5 #35552
SX: This document is available via SIRCExpress Order Number S-840007, https://secure.sportquest.com/su.cfm?articleno=S-840007&title=S-840007

Record 133 of 281 - SPORT Discus

TI: Science and the major racket sports: a review

(Etude de la science et des principaux sports de raquette.)
AU: Lees,-A
SO: Journal-of-sports-sciences-(London) 21(9), Sept 2003, 707-732, Total No. of Pages: 26
CN: Symposium on Science and Sports (2002: Liverpool, England)
PY: 2002
LE: Advanced
DE: REVIEW-; RACQUET-SPORT; SPORTS-SCIENCE; BIOMECHANICS-; EXERCISE-PHYSIOLOGY; SPORTS-MEDICINE
SH: (688127) RACQUET-SPORTS PHYSIOLOGY; (688111) RACQUET-SPORTS MEDICINE
AB: The major racket sports include badminton, squash, table tennis and tennis. The growth of sports science and the commercialization of racket sports in recent years have focused attention on improved performance and this has led to a more detailed study and understanding of all aspects of racket sports. The aim here, therefore, is to review recent developments of the application of science to racket sports. The scientific disciplines of sports physiology and nutrition, notational analysis, sports biomechanics, sports medicine, sports engineering, sports psychology and motor skills are briefly considered in turn. It is evident from these reviews that a great deal of scientific endeavor has been applied to racket sports, but this is variable across both the racket sports and the scientific disciplines. A scientific approach has helped to: implement training programs to improve players' fitness; guide players in nutritional and psychological preparation for play; inform players of the strategy and tactics used by themselves and their opponents; provide insight into the technical performance of skills; understand the effect of equipment on play; and accelerate the recovery from racket-arm injuries. Racket sports have also posed a unique challenge to scientists and have provided vehicles for developing scientific methodology. Racket sports provide a good model for investigating the interplay between aerobic and anaerobic metabolism and the effect of nutrition, heat and fatigue on performance. They have driven the development of mathematical solutions for multi-segment interactions within the racket arm during the performance of shots, which have contributed to our understanding of the mechanisms of both performance and injury. They have provided a unique challenge to sports engineers in relation to equipment performance and interaction with the player. Racket sports have encouraged developments in notational analysis both in terms of analytical procedures and the conceptualization of strategy and tactics. Racket sports have provided a vehicle for investigating fast interceptive actions, hand-eye coordination and perception-action coupling in the field of motor control. In conclusion, science has contributed considerably to our knowledge and understanding of racket sports, and racket sports have contributed to science by providing unique challenges to researchers.
ITSH: (688127) SPORT-CON-LA-RACCHETTAI FISIOLOGIA; (688111) SPORT-CON-LA-RACCHETTAI MEDICINA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-930985, https://secure.sportquest.com/su.cfm?articleno=S-930985&title=S-930985

Record 134 of 281 - SPORT Discus

TI: Temporal patterns of physical activity in Olympic dinghy racing

(Modeles temporels d' activite physique lors des competitions de voile olympique sur deriveur.)
AU: Legg,-S; Mackie,-H; Smith,-P
SO: Journal-of-sports-medicine-and-physical-fitness-(Torino) 39(4), Dec 1999, 315-320, Total No. of Pages: 6
PY: 1999
LE: Advanced
DE: YACHTING-; DINGHY-; ELITE-ATHLETE; FIELD-TEST; TIME-FACTOR; EXERCISE-
SH: (454127) YACHTING PHYSIOLOGY

AB: The objective of the present study was to determine the temporal patterns of physical activity in four classes of Olympic racing dinghy. Experimental design: Descriptive. Setting: A field (on-water) study. Participants: Nineteen elite New Zealand sailors (fifteen male and four female). Intervention: Not applicable. Measures: The temporal pattern (duration and frequency) and nature of the physical activities of each sailor during each leg of simulated races were recorded on video tape and subsequently systematically quantified and categorized using notational analysis. The accumulated percentage of total leg time spent sitting (upright or leaning backwards), hiking (upright or fully extended) whilst trimming and whilst pumping the mainsheet and for the time spent on rig adjustments, tacking and gybing were calculated for both up-wind and off-wind sailing. When sailing up-wind, the most time was spent hiking upright (average 29-66 % of total leg time) while trimming the mainsheet. During off-wind sailing, sailors spent the most time sitting upright while trimming the mainsheet (average 29-55 % total leg time). Hiking upright while trimming the mainsheet was executed the greatest number of times (average 15.8-23.9) when sailing up-wind and sitting upright while trimming was executed the most times (average 3.5-7.4) when sailing off-wind. The most lengthy continuous activity was hiking upright while trimming the mainsheet when sailing up-wind (9-18 seconds) and sitting upright while trimming the mainsheet when sailing off-wind (17-34 seconds). The most physically demanding aspect of Olympic yacht racing is hiking. It occurs for the majority of up-wind legs when the wind starts to exceed the majority of up-wind legs when the wind starts to exceed approximately 8 knots. The only respite that the sailor gets from hiking is during tacking, rig adjustments or sitting inboard for brief periods when the wind is low. Sustained hiking tends to last for no more than approximately 20 seconds before the sailor changes to either a more extended or more upright hiking posture. The physical demands during off-wind sailing are generally less, except for a greater requirement for power in the arms and shoulders to pump the mainsheet in order to assist the dinghy in accelerating down waves. The findings of the present study are directly applicable to the design of sailing specific physical conditioning programmes for Olympic class sailors.
ITSH: (454127) VELA FISIOLOGIA
CL: RC1200 #680
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-164420, https://secure.sportquest.com/su.cfm?articleno=S-164420&title=S-164420

TI: Steps towards fairer one-day cricketing measures of performance

AU: Lewis,-T
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.198-213, Total No. of Pages: 16
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: ONE-DAY-CRICKET; MATCH-ANALYSIS; STATISTICS-; PERFORMANCE-; EVALUATION-; MATHEMATICAL-MODEL
SH: (552110) CRICKET MATHEMATICS; (552310) CRICKET TESTING-AND-EVALUATION
AB: The traditional batting measures of performance in one-day cricket are the average number of runs for each dismissal and the batsman's rate of scoring runs per 100 balls received, known as his strike rate. For a bowler the traditional measures are the average number of runs per wicket taken, the average number of overs between wickets, known as the strike rate, and thirdly, the economy rate representing the average number of runs conceded per six-ball over. These measures are known to be inadequate and rarely tell the full story of player performances as the context in which runs are scored or conceded and wickets lost or taken are not taken into account. The methodology of the Duckworth/Lewis (D/L) method that is used to reset targets in interrupted one day matches can be utilised to evaluate better the performances of players, having regard for the stages of an innings that runs are earned and conceded and wickets lost or taken. The D/L method uses the concept of a team's combined resources of wickets and overs available in order to produce fair revised targets. This paper applies these proposed measures both to a single match and to a series of matches. It shows that the traditional measures can be seriously misleading in evaluating comparative player performances over a series, and totally inadequate in comparing batsmen and bowlers, and in combining an individual's performance with both the bat and the ball.
ITSH: (552110) CRICKET MATEMATICA; (552310) CRICKET TEST

TI: (Analysis of status of technique development in Chinese male junior elite table tennis players from the 4th city games of China.)

AU: Li,-J-L; Zhang,-R-B; Cai,-X-L
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 23(3), 2000, 395-396;405, Total No. of Pages: 3
PY: 2000
LE: Advanced
DE: TABLE-TENNIS; ELITE-ATHLETE; ADOLESCENT-; BOY-; TECHNIQUE-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (706192) TABLE-TENNIS TECHNIQUES-AND-SKILLS
AB: A survey of the methods of grip and stroke was made in the male junior table tennis players taking part in the 4th City Games of China and technical statistics was done to part of the players. Contrasting with the former reports concerned, the present situation of the technique development in the Chinese male elite junior table tennis players was deeply analyzed and corresponding suggestions were advanced.
ITSH: (706192) TENNIS-TAVOLO TECNICO

Record 137 of 281 - SPORT Discus

TI: Technical statistics on sub-district match of the third CUBA analyzed by spss.

AU: Li,-S-W; Liu,-G; Gang,-S-H
SO: Journal-of-Xi'an-institute-of-physical-education-(Xi'an,-P.R.China) 19(1), 2002, 80-81, Total No. of Pages: 2
PY: 2002
LE: Advanced
DE: STATISTICS-; UNIVERSITY-; BASKETBALL-; MATCH-ANALYSIS; EVALUATION-
SH: (546156) BASKETBALL RESEARCH-METHODS; (546310) BASKETBALL TESTING-AND-EVALUATION
AB: The authors study the special feature of technique and the problems existed in sub-district match by calculating the technical statistics on sub-district match of the third CUBA. We think the important aspects are to improve the rate of the shoot, especially the 3-point, decrease the faults. It is the key to enhance the sports level.
ITSH: (546156) PALLACANESTRO RICERCA-METODO; (546310) PALLACANESTRO TEST

Record 138 of 281 - SPORT Discus

TI: Space-time analyses on the confronting techniques in basketball

AU: Li,-X-L
SO: Journal-of-Chengdu-Physical-Education-Institute 26(3), 2000, 85-88, Total No. of Pages: 4
PY: 2000
LE: Advanced
DE: BASKETBALL-; WORLD-CHAMPIONSHIP; TECHNIQUE-; MATCH-ANALYSIS; ELITE-ATHLETE
SH: (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: Scientific space-time analyses of the 1998-1999 basketball league for the concerning techniques in shooting, passing and receiving and rebounding in confrontations indicate the overall distances between Chinese teams and the 8 top teams at the world championship. These distances are distributed through the three periods of basketball techniques-space-time analyzing, gaining and controlling, which not only reveals the fact that Chinese players lag behind the others in techniques, but also urges us to come up with some new ideas and measures in basketball training and its contents.
ITSH: (546192) PALLACANESTRO TECNICO

Record 139 of 281 - SPORT Discus

TI: Research into the relationship between the particular of time structure and energy supply way in badminton match.

AU: Li,-Y; Ling,-W
SO: Journal-of-Guangzhou-Physical-Education-Institute-(Guangzhou,-China) 17(3), 1997, 26-31, Total No. of Pages: 6

PY: 1997
LE: Advanced
DE: BADMINTON-; MATCH-ANALYSIS; TIME-; ENERGY-; LACTATE-; BLOOD-; METABOLISM-
SH: (690310) BADMINTON TESTING-AND-EVALUATION; (980200) PHYSIOLOGY-ENERGY-METABOLISM-ENERGY-COST
AB: The time structures for Guangdong badminton team's international and national 42 competitions in 1992 and the values of blood lactic acid after the competitions were measured. Results show the round sport time of badminton match and the internal time of one are respectively 3-6 seconds and 10-15 seconds, and the time structure in the different competitions differs, and the containing of blood lactic acid as well increase with the proportion of the round sports time of over 15 seconds increasing, and it will decrease with the proportion of the round sports time of below 3 seconds increasing. In the competition, on the basis of aerobic metabolism, the energy supply way with ATP-CP is the main way, and the energy supply way with glycolysis (ELP) is the supplementary way.
ITSH: (690310) BADMINTON TEST; (980200) FISIOLOGIA-METABOLISMO-ENERGETICO-COSTO-ENERGETICO

Record 140 of 281 - SPORT Discus

TI: Notational analysis of rallies in European circuit badminton

AU: Liddle,-D; O'-Donoghue,-P
PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 275-281, Total No. of Pages: 7
CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).
PY: 1998
LE: Advanced
DE: BADMINTON-; EUROPE-; NOTATION-; PHYSIOLOGY-
SH: (690310) BADMINTON TESTING-AND-EVALUATION; (690127) BADMINTON PHYSIOLOGY; (909390) EUROPE
ITSH: (690310) BADMINTON TEST; (690127) BADMINTON FISIOLOGIA; (909390) EUROPA
CL: GV990 #34134
SX: This document is available via SIRCExpress Order Number 480702, https://secure.sportquest.com/su.cfm?articleno=480702&title=480702

Record 141 of 281 - SPORT Discus

TI: Notational analysis of rallies in european circuit badminton
(Analyse des echanges dans le circuit europeen de badminton)
AU: Liddle-D/-O'-Donoghe-P
SO: Science and racket sports II : proceedings of the second world congress of science and racket sports and fifth international table tennis federation sports science congress, 22-25 April 1997 / Ed. by A. Lees, M. Hughes, I. Maynard,...[et al].- Londres : Spon, 1998 ROYAUME UNI, pp 275-281, 6 p., Notes bibliogr. p 280-281
PY: 1998
LE: Advanced

Record 142 of 281 - SPORT Discus

TI: Developing indexes of efficiency in basketball: talk with the coaches in their own language

(Razvijati indekse uspjesnosti u kosarci znaci govoriti trenerima njihovim jezikom.)
(Entwicklung von Effizienzindexen im Basketball: mit den Trainern auf ihrer sprache Kommunizieren.)
AU: Lidor,-R; Arnon,-M
SO: Kinesiology-(Zagreb) 32(2), Dec 2000, 31-41, Total No. of Pages: 11
PY: 2000
LE: Advanced
DE: EVALUATION-STUDY; BASKETBALL-; ELITE-ATHLETE; EUROPEAN-CHAMPIONSHIP; MATCH-ANALYSIS; SKILL-; COACHING-
SH: (546118) BASKETBALL PERCEPTUAL-MOTOR-PROCESSES

AB: Achieving a high level of performance in ball-game activities such as basketball depends upon (a) the technical skill level of the player within the team and of the whole team, and (b) the psychological, mental, and emotional edge over the opposing team. However, both coaches and players seem to emphasise the technical aspects of the game when preparing for a long-duration championship, a tournament, or a single game. The purpose of this study was to examine the correlational relationship among indexes of efficiency, technical and height variables and the final placing of a team in a 9-day championship. More specifically, two questions were raised in this study: (a) Is it possible to predict the final placing of a team based on its technical playing ability? (b) Is it possible to develop appropriate indexes to measure team ability and predict its final success? Based on the data obtained in the European Basketball Championship for teams under 19 years of age, two indexes of efficiency were developed. In addition, nine technical variables of the game of basketball were analysed. Spearman rank-order and Pearson product-moment correlations were used to examine the relationship between each index and variable and the final placing of a team, and the relationships between all variables. It was concluded that it was possible to use indexes of efficiency such as index of playing ability, and technical variables such as final scores and 2-point percentages, to predict the final ranking of a team. However, in order to promote the prediction process in ball-game activities it is recommended that researchers and practitioners develop multi-face indexes in which psychological, as well as technical, variables are considered.
ITSH: (546118) PALLACANESTRO ABILITA-MOTORIA
CL: QP302 P4 #220
SX: This document is available via SIRCExpress Order Number S-673028, https://secure.sportquest.com/su.cfm?articleno=S-673028&title=S-673028

Record 143 of 281 - SPORT Discus

TI: Research on status of performing compulsory exercises of Wushu routine for the ninth national games

AU: Lin,-X-M
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 23(3), 2000, 411-412, Total No. of Pages: 2
PY: 2000
LE: Intermediate
DE: WU-SHU; COMPULSORIES-; TECHNIQUE-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (687174) WU-SHU SPORTING-EVENTS
AB: The status of performing the compulsory exercises of Wushu routine for the Ninth National Games was observed on-the-spot in the first 12 female athletes taking part in the individual event of the optional events in the Chinese National Wushu Championship (individual competition) in 1999. The purpose to study and analyze this status is to reveal the key problems in training so as to arouse the sports teams' attention to carry out pertinent training.
ITSH: (687174) WU-SHU COMPETIZIONE-SPORTIVA

Record 144 of 281 - SPORT Discus

TI: Analysis of the disparity between Chinese and Cuban women volleyball teams

AU: Liu,-B; Yuan,-J
SO: Sports-science-(Beijing) 17(4), 7 July 1997, 44-47, Total No. of Pages: 4
PY: 1997
LE: Advanced
DE: VOLLEYBALL-; COMPARATIVE-STUDY; WOMAN-; TECHNIQUE-; EVALUATION-; DATA-COLLECTION; STATISTICS-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA; CUBA-; OLYMPIC-GAMES,-ATLANTA-1996; WORLD-CUP
SH: (588177) VOLLEYBALL STATISTICS-AND-RECORDS; (588312) VOLLEYBALL TRAINING-AND-CONDITIONING
ITSH: (588177) PALLAVOLO STATISTICA; (588312) PALLAVOLO ALLENAMENTO-E-CONDIZIONAMENTO
SX: This document is available via SIRCExpress Order Number 436557, https://secure.sportquest.com/su.cfm?articleno=436557&title=436557

Record 145 of 281 - SPORT Discus

TI: Analysis on technique level of "Kang Fu Lai Cup" National Championship of Taekwondo in 1997

AU: Liu,-B; Zhao,-Q; Lu,-F
SO: Journal-of-Xi'an-Institute-of-Physical-Education-(Xi'an,-China) 15(2), 1998, 37-41, Total No. of Pages: 5
PY: 1998
LE: Intermediate
DE: TAE-KWON-DO; TECHNIQUE-; EVALUATION-; ELITE-ATHLETE; ATHLETE-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA; SEX-FACTOR; SKILL-; COMPARATIVE-STUDY
SH: (682192) TAE-KWON-DO TECHNIQUES-AND-SKILLS; (682048) TAE-KWON-DO COUNTRIES-AND-REGIONS; (909720) PEOPLE'S-REPUBLIC-OF-CHINA
AB: The authors conducted on-the-spot technique analysis of all the 335 matches of the National Championship of Taekwondo held in 1997. The statistics indicate that the average use rate of which is over 50%, are the key techniques to score. The male athletes are superior to the female athletes not only in the training level, but also in the mastery and application of both essential and difficult techniques. The great disparities in score and strength between the champions and the ordinary athletes show that the balanced development of taekwondo has not been obtained in different areas. The lack of reserve forces will hinder the development of taekwondo in our country. Therefore, the popularization of taekwondo should be enhanced and the importance should be attached to the all-round development in techniques.
ITSH: (682192) TAE-KWON-DO TECNICO; (682048) TAE-KWON-DO PAESI-E-AREE; (909720) CINA-POPOLARE
SX: This document is available via SIRCExpress Order Number S-41502, https://secure.sportquest.com/su.cfm?articleno=S-41502&title=S-41502

Record 146 of 281 - SPORT Discus

TI: Study on the home court advantage in CBA

AU: Liu,-J-K; Li,-Z-G; Wang,-X-F; Liu,-Y-W
SO: Journal-of-physical-education-(Beijing,-P.R.China) 9(1), 2002, 117-119, Total No. of Pages: 3
PY: 2002
LE: Advanced
DE: SPORT-; BASKETBALL-; COURT-; GAME-LOCATION; HOME-ADVANTAGE; MATCH-ANALYSIS
SH: (546147) BASKETBALL PSYCHOLOGY
AB: The paper describes the home court advantage in CBA with statistics and analysis based on the tournament results of CBA from 1995-1996 season to 1999-2000 season. It is found that there is obvious home court advantage in CBA. The main factors leading to the home court advantage are described, which include circumstance, spectators, climate, referees, the factors of the basket team own etc.
ITSH: (546147) PALLACANESTRO PSICOLOGIA

Record 147 of 281 - SPORT Discus

TI: Analysis of technical and tactical characteristics of basketball team of Beijing capital iron and steel plant in home games of 1999-2000 CBA

AU: Liu,-Y; Wu,-G-Z; Gao,-B; Wen,-B-B
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 23(3), 2000, 397-399;422, Total No. of Pages: 4
PY: 2000
LE: Advanced
DE: BASKETBALL-; MAN-; CASE-REPORT; STATISTICS-; STRATEGY-; TECHNIQUE-; 1999-; 2000-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (546180) BASKETBALL STRATEGY; (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: China Basketball Games of Men's Class A is abbreviated to CBA. It is the highest-level games in China now. As an old-brand powerful force of Class A, the basketball team of the Beijing Capital Iron and Steel Plant rectified its troop during the season. After the replacement of the old and the new players the lineup of the top players was made up accompanying with the change of technical and tactical style. By applying game technical statistics, tracing investigation, data analysis, induction and arrangement, the home games of the men's basketball team of the Beijing Capital Iron and Steel Plant were summarized. And the main technical and tactical indexes were analyzed as well. The purpose of this study is to provide valuable and feasible materials for all the men's basketball teams, including the team of the Beijing

Capital Iron and Steel Plant and the basketball fans. From this side they can know the general situation of the Chinese men's basketball teams of Class A so as to improve their own level by pertinent training. The results of this study are as follows: 1. The main offensive areas of the team of the Beijing Capital Iron and Steel Plant are the center areas. The bucket play is combined with the high post play. In defence play the open defence man-for-man marking is the main. The technique characteristics of the top players of the team are outstanding, but they are not enough for replacement, which leads to the less change of technique and tactics. A pressing matter of the moment is to train more young players for the improvement of the whole actual strength of the team.

ITSH: (546180) PALLACANESTRO TATTICA; (546192) PALLACANESTRO TECNICO

TI: Cardiac and metabolic strain in beach-volleyball. (Abstract)

AU: Lorenz,-R; Roll,-C; Wiebke,-D; Jeschke,-D
SO: International-journal-of-sports-medicine-(Stuttgart) 23(Suppl.2), July 2002, S106, Total No. of Pages: 1
CN: German Congress of Sports Medicine and Prevention (37th : 2001 : Rotenburg a.d. Fulda.)
PY: 2001
LE: Advanced
DE: BEACH-VOLLEYBALL; CARDIOVASCULAR-SYSTEM; METABOLISM-; STRAIN-; MAN-; WOMAN-; YOUNG-ADULT; MATCH-ANALYSIS; HEART-RATE; LACTATE-; OXYGEN-CONSUMPTION; STEP-TRAINING; TREADMILL-; COMPARATIVE-STUDY
SH: (589127) BEACH-VOLLEYBALL PHYSIOLOGY; (979400) PHYSIOLOGY-CARDIOVASCULAR-HEMODYNAMICS; (983400) PHYSIOLOGY-MUSCLE-METABOLISM
ITSH: (589127) VOLLEYBALL-DELLA-SPIAGGIA FISIOLOGIA; (979400) FISIOLOGIA-CARDIOVASCOLARE-CIRCOLAZIONE-DEL-SANGUE; (983400) FISIOLOGIA-MUSCOLO-METABOLISMO
CL: RC1200 #580
SX: This document is available via SIRCExpress Order Number S-839570, https://secure.sportquest.com/su.cfm?articleno=S-839570&title=S-839570

TI: Comparison of Brazil and her opponents in the 1994 World Cup using a new notational analysis system. (Abstract)

(Comparaison du jeu de lequipe bresilienne et de ses adversaires lors de la Coupe du Monde 1994, en utilisant un nouveau systeme d' analyse.) (Resume)
AU: Luhtanen,-P; Korhonen,-V; Ilkka,-A
SO: Journal-of-sports-sciences-(London) 13(6), 1995, 515-516, Total No. of Pages: 2
CN: World Congress of Science and Football (3rd : 1995 : Cardiff, Wales).
PY: 1995
LE: Advanced
DE: SOCCER-; WORLD-CUP; ELITE-ATHLETE; 1994-; OBSERVATION-; VIDEOTAPE-; COMPARATIVE-STUDY; BRAZIL-
SH: (576310) SOCCER TESTING-AND-EVALUATION
ITSH: (576310) CALCIO TEST
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-919424, https://secure.sportquest.com/su.cfm?articleno=S-919424&title=S-919424

TI: A game performance analysis by age and gender in national level Finnish youth soccer players

AU: Luhtanen,-P; Vanttinen,-T; Hayrinen,-M; Brown,-E-W
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.275-279, Total No. of Pages: 5
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002

LE: Advanced
DE: SOCCER-; ADOLESCENT-; AGE-FACTOR; MATCH-ANALYSIS; SEX-FACTOR; COMPARATIVE-STUDY; FINLAND-
SH: (576177) SOCCER STATISTICS-AND-RECORDS
ITSH: (576177) CALCIO STATISTICA

Record 151 of 281 - SPORT Discus

TI: Effect of pitch type, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers

(Effet du type de lancer, du nombre de lancer et de la mecanique du lancer sur le risque de douleur au coude et a l' epaule chez des jeunes lanceurs de base-ball.)
AU: Lyman,-S; Fleisig,-G-S; Andrews,-J-R; Osinski,-E-D
SO: American-journal-of-sports-medicine-(Waltham,-Mass.) 30(4), July/Aug 2002, 463-468, Total No. of Pages: 6
PY: 2002
LE: Advanced
DE: PROSPECTIVE-STUDY; BASEBALL-; ADOLESCENT-; ATHLETE-; PITCHER-; PITCHING-; BIOMECHANICS-; PAIN-; SHOULDER-; ELBOW-
SH: (544093) BASEBALL INJURIES-AND-ACCIDENTS; (960450) INJURIES-AND-ACCIDENTS-SHOULDER-AND-UPPER-LIMB-INJURIES; (544273) BASEBALL TECHNIQUES-AND-SKILLS-PITCHING
AB: Joint pain is thought to be an early sign of injury to a pitcher. To evaluate the association between pitch counts, pitch types, and pitching mechanics and shoulder and elbow pain in young pitchers. Prospective cohort study. Four hundred and seventy-six young (ages 9 to 14 years) baseball pitchers were followed for one season. Data were collected from pre- and postseason questionnaires, injury and performance interviews after each game, pitch count logs, and video analysis of pitching mechanics. Generalized estimating equations and logistic regression analysis were used. Half of the subjects experienced elbow or shoulder pain during the season. The curveball was associated with a 52 %increased risk of shoulder pain and the slider was associated with an 86 % increased risk of elbow pain. There was a significant association between the number of pitches thrown in a game and during the season and the rate of elbow pain and shoulder pain. Pitchers in this age group should be cautioned about throwing breaking pitches (curveballs and sliders) because of the increased risk of elbow and shoulder pain. Limitations on pitches thrown in a game and in a season can also reduce the risk of pain. Further evaluation of pain and pitching mechanics is necessary.
ITSH: (544093) BASEBALL INFORTUNI-E-INCIDENTI; (960450) INFORTUNI-E-INCIDENTI-INFORTUNI-SPALLE-E-BRACCIA; (544273) BASEBALL TECNICO-LANCIO
CL: RC1200 #661
SX: This document is available via SIRCExpress Order Number S-839852, https://secure.sportquest.com/su.cfm?articleno=S-839852&title=S-839852

Record 152 of 281 - SPORT Discus

TI: Australian contributions to the analysis of performance in football 1963-1988

AU: Lyons,-K
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.121-125, Total No. of Pages: 5
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: AUSTRALIA-; RESEARCH-; MATCH-ANALYSIS; STATISTICS-; REVIEW-; SOCCER-; AUSTRALIAN-FOOTBALL; RUGBY-LEAGUE; RUGBY-UNION
SH: (992200) RESEARCH-AND-RESEARCH-METHODS-RESEARCH; (576156) SOCCER RESEARCH-METHODS
ITSH: (992200) ; (576156) CALCIO RICERCA-METODO

Record 153 of 281 - SPORT Discus

TI: A kinematic and kinetic analysis of the freestyle and butterfly turns

AU: Lyttle,-A-D; Mason,-B
SO: Journal-of-swimming-research-(Fort-Lauderdale,-Fla.) 12Fall 1997, 7-11, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: SWIMMING-; BUTTERFLY-; FREESTYLE-; TURN-; KINEMATICS-; KINETICS-; EVALU-ATION; ELITE-ATHLETE; YOUNG-ADULT; MAN-
SH: (408027) SWIMMING BIOMECHANICS; (408192) SWIMMING TECHNIQUES-AND-SKILLS
AB: Swim turns represent an integral factor in determining the final outcome of a swimming race. The aim of this study was to provide a comprehensive analysis of the kinetic and kinematic parameters which affect the turning performance of elite swimmers in a freestyle flip turn and a butterfly turn. Four butterfly (age:21.3 2.6 yrs; height: 1.85 4.13 m; weight: 82.6 1.9 kg) and three freestyle (age: 19.0 1.0 yrs; height: 1.88 9.42 m; weight: 77.5 3.6 kg) elite male swimmers performed seven complete turns with key kinetic and kinematic variables recorded for each turn. The kinetic analysis was performed using a 3D Kistler force plate mounted on the wall under the starting block. The kinematic analysis was performed through the use of the Kinex Swimming Analysis System which involved underwater and above-water video analysis of the approach, push-off and glide phases of the turn. Due to the limited subject population, the analysis was restricted to descriptive statistics of means and standard deviations for each of the kinetic and kinematic variables. A comparison of the present results demonstrated that the butterfly turn exhibited a greater average impulse (369.1 35.4 vs 247.3 29.0 Ns) and peak force (1406.7 117.2 vs 1345.3 236.5 N) and a longer average time on the wall (0.40 0.03 vs 0.29 0.05 s) than the freestyle turn. This longer time on the wall for the butterfly turns led to a slower push-off speed (1.33 0.11 vs 1.47 0.19 m/s) compared to the freestyle turns. Despite the case study approach, it was demonstrated that the collection of the kinematic and kinetic variables used in this study allowed a more comprehensive analysis of the freestyle and butterfly turns.
ITSH: (408027) NUOTO BIOMECANICA; (408192) NUOTO TECNICO
CL: GV836.2 #300
SX: This document is available via SIRCExpress Order Number 462153, https://secure.sportquest.com/su.cfm?articleno=462153&title=462153

Record 154 of 281 - SPORT Discus

TI: An analysis of applying defense and counterattack in Sanshou Grade-passing Games.

AU: Ma,-S-K
SO: Journal-of-Wuhan-institute-of-physical-education-(Wuhan,-P.R.China) 36(1), 2002, 50-52, Total No. of Pages: 3
PY: 2002
LE: Advanced
DE: ATHLETE-; DEFENCE-; COUNTERATTACK-; MATCH-ANALYSIS; WU-SHU
SH: (687180) WU-SHU STRATEGY
AB: Defense and counterattack are techniques used by high level athletes, characteristic of attacking while defending, winning over the stronger and winning by wit etc. Sanshou players should learn to apply defense and counterattack in real games in order to get better results.
ITSH: (687180) WU-SHU TATTICA

Record 155 of 281 - SPORT Discus

TI: Useful biomechanics for sailing: development of technique analysis protocol for Europe and Laser sailors

AU: Mackie,-H
PB: In Legg, S.J. (ed.), Massey University, Human performance in sailing conference proceedings: incorporating the 4th European Conference on Sailing Sports Science and Sports Medicine and the 3rd Australian Sailing Science

Conference, 9-10 January 2003, Auckland, New Zealand, [Palmerston North, New Zealand], Massey University, 2003, p.71-75, Total No. of Pages: 5

CN: Human Performance in Sailing Conference (2003 : Auckland, N.Z.)

PY: 2003

LE: Advanced

DE: YACHTING-; BIOMECHANICS-; VIDEOTAPE-; VISUAL-FEEDBACK; LASER-; PLANING-; EUROPE-

SH: (454027) YACHTING BIOMECHANICS

AB: A video analysis protocol has been established for assessing hiking technique in Europe and Laser sailors. A reliable estimation of 'hiking torque' - a direct measure of the sailor's hiking effectiveness, has been determined for two Europe sailors and three Laser sailors using Silicon Coach video analysis software. The sailor's hiking torque has then been explained by expressing their ankle, hip and shoulder positions relative to the mid-line of the boat, and by measuring knee and hip joint angles. Comparisons between sailors are given. The information can be used directly in technique adjustment or physical conditioning prescription. Other measures that have been identified as useful include, boat and heel pitch, tiller range of movement, and the effects of fatigue on hiking performance. Video analysis for improving downwind technique will probably be in the areas of temporal analysis (catching waves, searching for cues etc) and course sailed rather than measuring the sailors position. Further work is needed to develop this.

ITSH: (454027) VELA BIOMECANICA

Record 156 of 281 - SPORT Discus

TI: Comparison of skills between gained and lost games in elite male volleyball teams. (Abstract)

AU: Maggina,-M; Karkali,-A; Kassabalis,-A; Bergeles,-N

PB: In Koskolou, M. (ed.), European College of Sport Science, Proceedings of the 7th annual congress of the European College of Sport Science, Athens, Greece, 24-28 July 2002. Volume I, Athens, Pashalidis Medical Publisher, c2002, p.505, Total No. of Pages: 1

CN: European College of Sport Science. Congress (7th: 2002: Athens)

PY: 2002

LE: Advanced

DE: VOLLEYBALL-; ELITE-ATHLETE; MAN-; ACHIEVEMENT-; SKILL-; OCCURRENCE-; MATCH-ANALYSIS; VIDEOTAPE-; RATING-SCALE; COMPETITION-; RESULTS-; ANALYSIS-OF-VARIANCE; COMPARATIVE-STUDY

SH: (588310) VOLLEYBALL TESTING-AND-EVALUATION; (588192) VOLLEYBALL TECHNIQUES-AND-SKILLS

ITSH: (588310) PALLAVOLO TEST; (588192) PALLAVOLO TECNICO

CL: GV 557.5 #35611 vol.I

SX: This document is available via SIRCExpress Order Number S-866676, https://secure.sportquest.com/su.cfm?articleno=S-866676&title=S-866676

Record 157 of 281 - SPORT Discus

TI: Effects of visual impairment on stroke parameters in Paralympic swimmers

(Effets du handicap visuel sur les parametres du mouvement chez des nageurs paralympiques.)

AU: Malone,-L-A; Sanders,-R-H; Schiltz,-J-H; Steadward,-R-D

SO: Medicine-and-science-in-sports-and-exercise-(Hagerstown,-Md.) 33(12), Dec 2001, 2098-2103, Total No. of Pages: 6

PY: 2001

LE: Advanced

DE: SPRINT-SWIMMING; HANDICAPPED-; BLINDNESS-; STROKE-; FREESTYLE-; COMPARATIVE-STUDY; SEX-FACTOR; DISABLED-PERSONS

SH: (418054) SPRINT-SWIMMING DISABLED; (418240) SPRINT-SWIMMING TECHNIQUES-AND-SKILLS-FREESTYLE; (906065) DISABLED-BLINDNESS; (418310) SPRINT-SWIMMING TESTING-AND-EVALUATION

AB: To examine the relationship between degree of vision and stroking parameters in male and female Paralympic swimmers with visual impairment during the 50- and 100-m freestyle events. A video analysis was conducted at the 1996 Paralympic Games in which swimmers competed in three groups based on degree of impairment (S11, S12, and S13; S11 least amount of vision). A video camera placed 25 m from the start, perpendicular to the swimming direction, recorded the performance of each swimmer during the clean swim phase. Variables measured included total race time,

clean swimming speed (CSS), stroke rate (SR), stroke length (SL), and stroke index (SI = CSS X SL). Comparisons of performance were made between the classes and between men and women. The men showed no significant differences between S12 and S13 on any of the variables or between all three classes on SL and SI. The S11 swimmers demonstrated a significantly slower total race time and CSS in both events. In the women, an increase in class was associated with a decrease in total race time, faster CSS, and increase in SI. In comparing men and women, men demonstrated a significantly faster CSS and total race time during both events, whereas no differences were observed in SR. Stroke parameters during the clean swim phase were affected by visual impairment in both men and women. The male classes, however, were not clearly distinct from each other based on the swimming variables measured, as no significant differences were found between S12 and S13 in either event. With the exception of stroke rate and length, performance of the women tended to increase with an increase in class.

ITSH: (418054) VELOCITA-NEL-NUOTO DISABILE; (418240) VELOCITA-NEL-NUOTO TECNICO-STILE-LIBERO; (906065) DISABILI-CECITA; (418310) VELOCITA-NEL-NUOTO TEST

CL: RC1200 #820

SX: This document is available via SIRCExpress Order Number S-799502, https://secure.sportquest.com/su.cfm?articleno=S-799502&title=S-799502

Record 158 of 281 - SPORT Discus

TI: Strategy evaluation of singles tennis matches in girls under 18 years old

AU: Mantis,-K

SO: Exercise-and-society-journal-of-sport-science-(Komotini) (21), 1999, 64-72, Total No. of Pages: 9

PY: 1999

LE: Advanced

DE: TENNIS-; ELITE-ATHLETE; ADOLESCENT-; GIRL-; MATCH-ANALYSIS; VIDEOTAPE-; STRATEGY-; SERVE-; SERVE-RETURN; BACKHAND-; FOREHAND-

SH: (708192) TENNIS TECHNIQUES-AND-SKILLS; (708180) TENNIS STRATEGY

AB: The purpose of this study was to evaluate the tactics strategy, that was used in single tennis matches for girls under 18 years old. The subjects were the National teams of female tennis players from 5 countries: Greece, Tzechia, Spain, Russia and Yugoslavia. Each team consisted of 2 female athletes. They played the number 1 and number 2 player in the National tennis ranking of each country. In order to collect the data, eight tennis matches were filmed (used of video camera). They were recorded 17 sets, 136 games and 925 points. The matches data were written in score sheets. A statistical analysis was done with the use of a P/C and the 'Computennis' program. With the help of this program, the serve, the return of the serve and the effectiveness for the last stroke of each point were analyzed. The data were analyzed with an analysis of variance, and the findings revealed that the factors success of the first and second serve, the effectiveness of the return for each serve, and the number of unforced errors determined the results of the matches. The study of the above mentioned factors give sufficient information for the tactical strategy of the tennis player.

ITSH: (708192) TENNIS TECNICO; (708180) TENNIS TATTICA

CL: GV701.P4 #1800

SX: This document is available via SIRCExpress Order Number S-657702, https://secure.sportquest.com/su.cfm?articleno=S-657702&title=S-657702

Record 159 of 281 - SPORT Discus

TI: Influence of some situation-related parameters on the score in volleyball

AU: Marelic,-N; Zufar,-G; Omrcen,-D

SO: Kinesiology-(Zagreb) 30(2), Dec 1998, 55-65, Total No. of Pages: 11

PY: 1998

LE: Advanced

DE: VOLLEYBALL-; ELITE-ATHLETE; SKILL-; STRATEGY-; MATCH-ANALYSIS; EUROPEAN-CHAMPIONSHIP

SH: (588192) VOLLEYBALL TECHNIQUES-AND-SKILLS; (588180) VOLLEYBALL STRATEGY

AB: The situation-related parameters of top volleyball matches were analyzed in this paper: five technical tactical elements (block, defence, serve, reception of serve and spike), performed by one volleyball team throughout the competition period and during the European Champions Cup matches, were monitored. The influence of these elements

on the score in a volleyball game was investigated. Two regression analysis models were used. Further, by means of numerous frequencies in descriptive statistics one model of performance efficiency for each of the five analyzed elements was designed.

ITSH: (588192) PALLAVOLO TECNICO; (588180) PALLAVOLO TATTICA

CL: QP302.P4 #220

SX: This document is available via SIRCExpress Order Number S-41011, https://secure.sportquest.com/su.cfm?articleno=S-41011&title=S-41011

Record 160 of 281 - SPORT Discus

TI: Spiel-Analyse im Badminton: Ein Bericht aus der Praxis

(Analyse de jeu en badminton, compte rendu d' experience.)

AU: Marlovits,-A-M; Kirchhof,-O

SO: Psychologie-und-Sport-Zeitschrift-fuer-Sportpsychologie-(Schorndorf) 8(3), Sept 2001, 101-107, Total No. of Pages: 7

PY: 2001

LE: Advanced

DE: BADMINTON-; PSYCHOLOGY-; TRAINING-; CASE-REPORT; WOMAN-; MATCH-ANALYSIS; GESTALT-PSYCHOLOGY; ACHIEVEMENT-; FAILURE-; LOSING-

SH: (690147) BADMINTON PSYCHOLOGY

AB: While researching for the head coach of the German national youth team in badminton, the game of a young talent was analysed. The central goal of this sport-psychological analysis has been the question of her unexpected and recurring defeats in contest with supposedly weaker opponents. This game-analysis has been conducted according to gestalt-psychological concepts. The essay describes process, method and procedure of this game-analysis and offers an insight in important results of the analysis.

ITSH: (690147) BADMINTON PSICOLOGIA

CL: GV706.4.P4 #220

SX: This document is available via SIRCExpress Order Number S-794099, https://secure.sportquest.com/su.cfm?articleno=S-794099&title=S-794099

Record 162 of 281 - SPORT Discus

TI: Reliability of gait parameters in children under two years of age

AU: Marques-Bruna,-P; Grimshaw,-P

SO: Perceptual-and-motor-skills-(Missoula,-Mont.) 98(1), Feb 2004, 123-130, Total No. of Pages: 8

PY: 2004

LE: Advanced

DE: WALKING-; GAIT-; KINEMATICS-; INFANT-; SURVEY-; FOLLOW-UP-STUDY; TEST-RELIABILITY; VIDEOCAMERA-; ANALYSIS-OF-VARIANCE; CASE-STUDY

SH: (904875) CHILDREN-AND-ADOLESCENTS-CHILD-DEVELOPMENT; (905120) CHILDREN-AND-ADOLESCENTS-TESTING; (946300) BIOMECHANICS-GAIT

AB: The walking movement of children of school age and adults can be regarded as very consistent. However, few studies have reported reliability of gait parameters in very young children that may be used as normative data for the clinical assessment of gait. In the present study, nine normal children of ages 10 to 21 mo. were assessed cross-sectionally using three-dimensional video analysis and digitization to assess within-day reliability of gait kinematics. Between-subject differences in gait kinematics were also examined. In addition, one child was assessed at the onset of independent walking and at monthly intervals thereafter to assess changes in gait kinematics during the first 8 mo. of autonomous walking. The case study allowed the acquisition of pilot data for longitudinal studies of this age group. 10 kinematics variables regarded as indicators of efficient walking were measured, and reliability was assessed using one-way analysis of variance and coefficient of variation. The study showed that all children produced reliable within-day results; however, the gait of each child was unique. In the case study, the between-month differences in gait kinematics were significant. The findings may be of clinical interest for pediatricians and child neurologists given the lack of normative data for this age group.

ITSH: (904875) BAMBINI-E-ADOLOSCENTE-SVILUPPO-INFANTILE; (905120) BAMBINI-E-ADOLOSCENTE-TEST; (946300) BIOMECCANICA-ANDATURA

TI: Variability in development of overarm throwing: a longitudinal case study over the first 6 months of throwing

AU: Marques-Bruna,-P; Grimshaw,-P-N
SO: Perceptual-and-motor-skills-(Missoula,-Mont.) 86(3 Part 2), June 1998, 1403-1418, Total No. of Pages: 16
PY: 1998
LE: Advanced
DE: THROWING-; MOTOR-SKILL; LONGITUDINAL-STUDY; INFANT-; CHILD-DEVELOPMENT; GIRL-; KINEMATICS-
SH: (971150) PERCEPTUAL-MOTOR-PROCESSES-CHILDREN-AND-ADOLESCENTS; (946400) BIOMECHANICS-KINEMATICS

AB: One female subject of 15 months of age, at the onset of overarm-throwing behaviour, was tested on a longitudinal study of throwing development. Data were collected at the onset of throwing and monthly thereafter, producing 6 sets of data. Kinematic variables were obtained using 3-dimensional video analysis and digitization. Qualitative observations showed that both arm-dominated and sequentially linked throws, right- and left-handed throws, and homolateral and contralateral forward steps were generated in an array of inconsistent throwing. Sequentially linked throws were generally "interrupted", whereby the child paused briefly after the Back swing to focus externally, then the child executed the propulsion. The throwing elbow remained flexed at ball release. Angles of ball release (referred to the horizontal) fluctuated from 2.17 degrees to 28.03 degrees for all 6 months of throwing development, and the speed of ball release varied from 2.08 m/sec. to 4.32 m/sec. Height of ball release oscillated between 91.5 percent and 103.3 percent of the child's height. Horizontal and vertical components of the velocity of the ball while in the hand differed amongst both arm-dominated and sequentially linked throws. The time of the Push up phase in arm-dominated throws varied from 0.14 sec. to 0.50 sec. In sequentially linked throws the time of the Back swing ranged from 0.18 sec. to 0.22 sec., and the Propulsion varied from 0.06 sec. to 0.14 sec. This work in identifying such variability is important, therefore, in the understanding of the motor skill of throwing.
ITSH: (971150) APPRENDIMENTO-PERCETTIVO-MOTOR-GIOVANE; (946400) BIOMECCANICA-CINEMATICA
CL: BF1.P4 #100

TI: Where are races won (and lost)?

AU: Mason,-B
PB: In Applied proceedings: swimming, Perth, W.A., Edith Cowan University, School of Biomedical and Sports Science, c1999, p.1-10, Total No. of Pages: 10
CN: International Symposium on Biomechanics in Sports (17th : 1999 : Western Australia)
PY: 1999
LE: Advanced
DE: SWIMMING-; WORLD-CHAMPIONSHIP; MATCH-ANALYSIS; MAN-; WOMAN-; CORRELATION-; PERFORMANCE-; SPEED-; STROKE-FREQUENCY; STROKE-LENGTH; START-; TURN-
SH: (408174) SWIMMING SPORTING-EVENTS
ITSH: (408174) NUOTO COMPETIZIONE-SPORTIVA
CL: GV838.53.B56 #34973

TI: Bilateral segmental dystonia in a professional tennis player

(Dystonie segmentale bilaterale chez un joueur professionnel de tennis.)
AU: Mayer,-F; Topka,-H; Boose,-A; Horstmann,-T; Dickhuth,-H-H
SO: Medicine-and-science-in-sports-and-exercise-(Baltimore,-Md.) 31(8), Aug 1999, 1085-1087, Total No. of Pages: 3
PY: 1999
LE: Advanced
DE: TENNIS-; DYSTONIA-; CASE-REPORT; COORDINATION-; ARM-; MUSCLE-
SH: (956350) DISEASES-AND-DISORDERS-MOVEMENT-DISORDERS; (708093) TENNIS INJURIES-AND-ACCIDENTS
AB: Dystonias occur frequently as repetitive movements, persistent elevations of muscle tone, or tonic contortions, whereby the cause is assumed to be an impairment of basal ganglia function. Focal dystonias are especially known in musicians, although little is reported on focal dystonias in athletic stress. The present case report describes the case of a 34-yr-old professional tennis player with bilateral segmental dystonia. The symptoms were expressed in involuntary movements when he intended to hit the ball and in a progredient tremor, initially in one hand, later in both, making him unable to write. The altered mobility during athletic stress was confirmed by video analysis, the altered innervation with excessive, uncoordinated impulse influx by means of electromyography during sport-type specific stress, and writing incapacity during a writing test. The symptoms abated under therapy with trihexyphenidyl-HCL, so that the patient has been able to work as a tennis coach with improved athletic performance for the past 3 yr. It is concluded that the various forms of dystonia should be included in the differential diagnosis of impaired coordinative movements under athletic exercise, especially of the upper extremities.
ITSH: (956350) MALATTIE-E-DISTURBI-DISTURBI-MOTORI; (708093) TENNIS INFORTUNI-E-INCIDENTI
CL: RC1200 #820
SX: This document is available via SIRCExpress Order Number S-75729, https://secure.sportquest.com/su.cfm?articleno=S-75729&title=S-75729

Record 166 of 281 - SPORT Discus

TI: Video analysis of the acute clinical manifestations of concussion in Australian rules football - abstract

AU: McCrory,-P
PB: In, Australian Conference of Science and Medicine in Sport, National Convention Centre, Canberra 7-10 October 1997 : abstracts, Bruce A.C.T., Sports Medicine Australia, 1997, p. 214-215
CN: Australian Conference of Science and Medicine in Sport (1997 : Canberra, A.C.T.)
PY: 1997
LE: Advanced
DE: AUSTRALIAN-FOOTBALL; BRAIN-CONCUSSION; MORBIDITY-
SH: (542093) AUSTRALIAN-FOOTBALL INJURIES-AND-ACCIDENTS; (958650) INJURIES-AND-ACCIDENTS-CONCUSSION
ITSH: (542093) FOOTBALL-AUSTRALIANO INFORTUNI-E-INCIDENTI; (958650) INFORTUNI-E-INCIDENTI-CONCUSSIONE

Record 167 of 281 - SPORT Discus

TI: Video analysis of acute motor and convulsive manifestations in sport-related concussion

AU: McCrory,-P-R; Berkovic,-S-F
SO: Neurology-(Philadelphia) 54(7), Apr 2000, 1488-1491, Total No. of Pages: 4
PY: 2000
LE: Advanced
DE: BRAIN-CONCUSSION; AUSTRALIAN-FOOTBALL; SPASM-; MOTOR-DISORDER; VIDEOTAPING-; EVALUATION-

SH: (958650) INJURIES-AND-ACCIDENTS-CONCUSSION; (542093) AUSTRALIAN-FOOTBALL INJURIES-AND-ACCIDENTS
ITSH: (958650) INFORTUNI-E-INCIDENTI-CONCUSSIONE; (542093) FOOTBALL-AUSTRALIANO INFORTUNI-E-INCIDENTI

TI: On the design of sports tournaments

AU: McGarry,-T
PB: In Statistics in sport, Arnold, p.199-217, Total No. of Pages: 19
PY: 1998
LE: Intermediate
DE: SPORT-; TOURNAMENT-; MATCH-ANALYSIS; DESIGN-; STATISTICS-
SH: (903945) ADMINISTRATION-TOURNAMENTS-AND-COMPETITIONS
ITSH: (903945) AMMINISTRAZIONE-TORNEI-E-COMPETIZIONI
CL: GV741 #34810
SX: This document is available via SIRCExpress Order Number S-125872, https://secure.sportquest.com/su.cfm?articleno=S-125872&title=S-125872

TI: Sport competition as a dynamical self-organizing system

(La competition sportive comme dynamique d' un systeme s ' auto-organisant.)
AU: McGarry,-T; Anderson,-D-I; Wallace,-S-A; Hughes,-M-D; Franks,-I-M
SO: Journal-of-sports-sciences-(London) 20(10), Oct 2002, 771-781, Total No. of Pages: 11
PY: 2002
LE: Advanced
DE: SQUASH-RACQUETS; SOCCER-; MATCH-ANALYSIS; SKILL-; PERFORMANCE-PREDICTION
SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS; (576118) SOCCER PERCEPTUAL-MOTOR-PROCESSES; (704118) SQUASH-RACQUETS PERCEPTUAL-MOTOR-PROCESSES
AB: The existence of structure in sport competition is implicated in the widespread practice of using the information gathered from a past contest to prepare for a future contest. Based on this reasoning, we previously analyzed squash match-play for evidence of signature traits from among the stochastic relations between the various types of shot. The mixed findings from these analyses led us to re-analyze squash match-play as a dynamical system. Here, we extend this line of investigation with some suggestions as to how various sports might be described further within this theoretical framework. We offer some examples of dynamical interactions in dyadic (i.e. one vs one) and team (e.g. many vs many) sports, as well as some predictions from a dynamical systems analysis for these types of sports contests. This paper should serve to initiate further research into the complex interactions that occur in sport competition.
ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA; (576118) CALCIO ABILITA-MOTORIA; (704118) SQUASH ABILITA-MOTORIA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-847008, https://secure.sportquest.com/su.cfm?articleno=S-847008&title=S-847008

TI: Analysing championship squash match-play as a dynamical system

AU: McGarry,-T; Khan,-M-A; Franks,-I-M
PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 221-226, Total No. of Pages: 6
CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).
PY: 1998
LE: Advanced

DE: SQUASH-RACQUETS; MATCH-ANALYSIS
SH: (704310) SQUASH-RACQUETS TESTING-AND-EVALUATION
ITSH: (704310) SQUASH TEST
CL: GV990 #34134
SX: This document is available via SIRCExpress Order Number 480693, https://secure.sportquest.com/su.cfm?articleno=480693&title=480693

TI: Analysis of the physical demands of international rugby union

AU: McLean,-D-A
SO: Journal-of-sports-sciences-(London) 10(3), June 1992, 285-296
PY: 1992
LE: Advanced
DE: RUGBY-UNION; PHYSICAL-FITNESS; MATCH-ANALYSIS; LACTATE-
SH: (574123) RUGBY-UNION PHYSICAL-FITNESS; (574127) RUGBY-UNION PHYSIOLOGY

AB: The aim of this study was to investigate the physical demands of international rugby union. Five games in the 1989-90 Five Nations Championship were analysed using video-recordings of live television transmissions. When the ball was in open play, the average running pace of players central to the action ranged from 5 to 8 m s-1. This together with scrum, lineout, ruck and maul was classified as high-intensity exercise. The density of work was measured by timing the work:rest ratios (W:RRs) were in the range 1:1 to 1:19. On average, a scrum, lineout, ruck or maul occurred every 33 s. The ball was in play for an average of 29 min during a scheduled time of play of 80 min. To complement the time-motion analysis, blood samples were taken from six players throughout a first-class game. The highest measured blood lactate (BLa) concentrations for each individual ranged from 5.8 to 9.8 mM. Running speed, duration, BLa levels, physical confrontation and, most particularly, the density of work as illustrated by the W:RRs indicate that the game places greater demands on anaerobic glycolysis than previously reported. This has implications for the physical conditioning of rugby union players.
ITSH: (574123) RUGBY-UNION CONDIZIONE-FISICA; (574127) RUGBY-UNION FISIOLOGIA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number 377341, https://secure.sportquest.com/su.cfm?articleno=377341&title=377341

TI: A psychological analysis of "required movement" stability in Wushu competition

AU: Mei,-H-C; Chen,-S-F
SO: Journal-of-Hubei-sports-science 19(2), 2000, 24-26, Total No. of Pages: 3
PY: 2000
LE: Intermediate
DE: WU-SHU; PSYCHOLOGY-; ANXIETY-; MATCH-ANALYSIS; STABILITY-
SH: (687147) WU-SHU PSYCHOLOGY

AB: "Required movements" have improved the competence and justice of wushu competition. This essay probes into the expression manners and causes of nervousness of the sportsmen in performing the "Required movements".
ITSH: (687147) WU-SHU PSICOLOGIA

TI: Konditionelle Faehigkeiten deutscher Spitzenfussballer im Laengsschnitt: Analytischer Vergleich mit Videoanalyse-Daten der Fussball-Bundesliga

   (Aptitude physique des joueurs de football de haut niveau en endurance, comparaison avec des donnees video du championnat allemand.)

TI: Longitudinal analysis of endurance and sprint abilities in elite German soccer players

AU: Meyer,-T; Ohlendorf,-K; Kindermann,-W

DE: SOCCER-; ELITE-ATHLETE; MAN-; ENDURANCE-; SPRINTING-; LONGITUDINAL-STUDY; MATCH-ANALYSIS; FEDERAL-REPUBLIC-OF-GERMANY
SH: (576192) SOCCER TECHNIQUES-AND-SKILLS; (576310) SOCCER TESTING-AND-EVALUATION

AB: To detect changes in the physical demand of soccer within the 90s data were collected from the ran data store (German private television). the 6 matches between the leading 3 first league teams at the end of the seasons 92/93 until 97/98 were analyzed from video tapes for the number of one-on-one plays, shots at goal, fouls, long passes and real playing time. Identifical analyses were performed for the matches of the German national soccer team within the same period of time. This was contrasted with data from field tests of German first league soccer players between 1991 and 1998 (sprint test 5 x 30m; graded running test starting with 10 km/h, 3 min-increments of 2 km/h). The individual anaerobic threshold (IAT) was determined as well as the times for 5, 10, and 30 m. The video analysis could not prove any changes in the dynamics of top level soccer. Significant differences over the years were rare. Additionally, there were no significant changes in endurance capacity (IAT 1991, 92, 94, and 98: 14,4,14,3, and 14.,3 km-h1
ITSH: (576192) CALCIO TECNICO; (576310) CALCIO TEST
CL: RC1200 #422
SX: This document is available via SIRCExpress Order Number S-658637, https://secure.sportquest.com/su.cfm?articleno=S-658637&title=S-658637

Record 174 of 281 - SPORT Discus

TI: Evaluation of a model of monitoring individual and team performance during attack in a competitive soccer game

(Evaluacija jednog modela za pracenje igre igraca i momcadi u napadu u uvjetima nogometne utakmice.)
(Die Bewertung eines Modells zur Betrachung der individuellen und Mannschaftsleistung in der Angriffsphase im Wettkampfsfussballspiel.)
AU: Miljkovic,-Z; Jerovic,-S; Simenc,-Z
DE: SOCCER-; OFFENCE-; EVALUATION-STUDY; MATCH-ANALYSIS; TEAM-; VIDEOTAPE-
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576189) SOCCER STRATEGY-OFFENSIVE
AB: The soccer game between Brazil and Scotland, played at the FIFA World Cup in France in 1998, was chosen to determine the applicability of a model intended for monitoring both the individual and the team performance in attack at a particular competition. The measurements were conducted on a set of variables that describe the events during attack in a soccer match. Contingency tables were used for data analysis where statistical significance of frequency distributions was determined by means of a chi-square test and the correlation by means of the contingency coefficient. The entities were attacks of the observed team and they were obtained by the summation of actions executed throughout the duration of attacks. The analysis of all variables made it possible to determine the differences between these two teams according to their type of play and according to different playing characteristics. Brazil was characterized by a larger number of actions executed (58.7 %), as compared to the Scottish team (41.3 %). The results also showed that the Brazilian team played more aggressively than the Scottish team and executed more actions in the sub-areas in the middle of the field and in the sub-areas closer to the opposing team's goal. Dribbling the ball over medium-long and long distances was dominant in the play of the Brazilian team. The Brazilian team executed a larger number of actions pertaining to the middle and to the final phase of the attack (60.2 % and 63.8 %, respectively) than did the Scottish team (39.8 % and 36.2 %, respectively). In both teams outside defenders and goalkeepers were dominant in the phase of attack commencement. Midfield players dominated in the middle phase and outside forwards in the final phase of attack. The applicability of the assessment tool was confirmed as regards the capacity to differentiate between the style of play of two soccer teams.
ITSH: (576310) CALCIO TEST; (576189) CALCIO TATTICA-ATTACCO
CL: QP302 P4 #220
SX: This document is available via SIRCExpress Order Number S-839060, https://secure.sportquest.com/su.cfm?articleno=S-839060&title=S-839060

Record 175 of 281 - SPORT Discus

TI: Effects of drafting on energy expenditure in in-line skating

(Effet du drafting sur la depense energetique en patinage en ligne.)

AU: Millet,-G-P; Geslan,-R; Ferrier,-R; Candau,-R; Varray,-A

SO: Journal-of-sports-medicine-and-physical-fitness-(Torino) 43(3), Sept 2003, 285-290, Total No. of Pages: 6

PY: 2003

LE: Advanced

DE: IN-LINE-SKATING; DRAFTING-; ENERGY-EXPENDITURE; SPEED-; DISTANCE-; NON-COMPETITOR; MAN-; OXYGEN-CONSUMPTION; COMPARATIVE-STUDY

SH: (869127) IN-LINE-SKATING PHYSIOLOGY; (869027) IN-LINE-SKATING BIOMECHANICS

AB: Aim: the purpose of this study was to measure the effects of drafting on energy expenditure in in-line skating, and to investigate whether the "benefit of drafting", i.e. the decrease in energy expenditure, was different between two velocities and two distances separating the two skaters. Methods: eight recreational in-line skaters performed six exercises of 6 min, at 2 velocities (V1 = 5.51 0.45 m.sec-1; V2 = 7.01 0.67 m.sec-1) in 3 conditions (ND = without drafting; D1 = 0.74-0.87 m "close"; D2 = 1.19-1.36 m "far"). Collection of expired gas was carried out using a breath-by-breath portable gas analyser K4b2 and the distance between the skaters was measured by video analysis. Results: the skaters' energy expenditure was reduced in all drafting conditions; between D1 and ND by 9.6 4.4 % at V1 and by 2.7 3.3 % at V2; between D2 and ND by 8.8 6.0 % at V1 and by 4.2 4.8 % at V2. This reduction was significantly (p < 0.05) more important at V1 than V2 and no differences were observed between D1 and D2. Conclusion: in in-line skating, the technical difficulties for drafting efficiently, especially while cornering, resulted in a reduced "benefit of drafting" at high velocity than in other sports. Moreover, the need for the subject to adjust their own cycle frequency to that of the lead skater while drafting "close" would explain partly that there were no significant differences between drafting at D1 and D2. These results suggest that the drafting technique should be emphasized in training, especially in non-skilled skaters at high velocities and when cornering.

ITSH: (869127) PATTINAGGIO-A-ROTELLE-IN-LINEA FISIOLOGIA; (869027) PATTINAGGIO-A-ROTELLE-IN-LINEA BIOMECANICA

CL: RC1200 #680

SX: This   document   is   available   via   SIRCExpress   Order   Number   S-923611, https://secure.sportquest.com/su.cfm?articleno=S-923611&title=S-923611

Record 176 of 281 - SPORT Discus

TI: A three-dimensional angular momentum analysis in the Asian top discus throwers

AU: Miyanishi,-T; Sakurai,-S; Wakayama,-A; Togashi,-T; Kawamura,-T

SO: Japanese-journal-of-biomechanics-in-sports-and-exercise-(Tokyo) 2(1), 1998, 10-18, Total No. of Pages: 9

PY: 1998

LE: Advanced

DE: DISCUS-THROW; MOVEMENT-; PATTERN-; KINEMATICS-; ANGULAR-MOMENTUM; MATCH-ANALYSIS; CINEMATOGRAPHY-; ELITE-ATHLETE; ASIAN-GAMES; MAN-; YOUNG-ADULT; ADULT-

SH: (746027) DISCUS-THROW BIOMECHANICS; (946400) BIOMECHANICS-KINEMATICS; (946860) BIOMECHANICS-TECHNIQUE-CINEMATOGRAPHY

AB: The purpose of this project was to clarify the angular momentum of Asian top discus athletes during the single support phase by right foot and the delivery phase, by using three-dimensional (3 D) cinematography. Top six finalists of the discus competition for the 12th Asian games in Hiroshima 1994 were filmed with two high-speed video cameras at 200 frames/s. The average distance of the top six was 56.44 1.84 m. 3 D landmark coordinates of 15 body segments were obtained by using the DLT method. The angular momentum (L) of the thrower and the velocity of the discus were calculated. We confirmed that there are two different patterns in the angular momentum of the thrower-plus-discus system during the delivery phase. One was the pattern of the gold-medalist, with rapid increase of the positive Lz with the negative Lx and the negative Lr decreasing. The other was that of the bronze-medalist, with marked increase of the negative Lx and the negative Lr with the positive Lz dropping. And also, time used from the instant of the ground contact by right foot to the release of discus was short in the gold-medalist (0.31 s) than in the bronze-medalist (0.42 s). Therefore, the pattern of the gold medalist could be called the motion of "high-speed type". On the other hand, the bronze-medalist called "low-speed type". The most important conclusion of this project was that "high-speed type" generates the horizontal speed of discus more than the vertical speed of discus during the second single support phase to the delivery phase. On the other hand, "low-speed type" continues increasing the vertical speed of discus more than the horizontal speed of discus during those phases.

ITSH: (746027) LANCIO-DEL-DISCO BIOMECANICA; (946400) BIOMECCANICA-CINEMATICA; (946860) BIOMECCANICA-CINEMATOGRAFIA

TI: Match performance of high-standard soccer players with special reference to development of fatigue

(Etude des performances et de la fatigue des joueurs lors d' un match de football.)
AU: Mohr,-M; Krustrup,-P; Bangsbo,-J
SO: Journal-of-sports-sciences-(London) 21(7), July 2003, 519-528, Total No. of Pages: 10
PY: 2003
LE: Advanced
DE: PROFESSIONAL-;   SOCCER-;   ELITE-ATHLETE;   TEAM-POSITION;   SKILL-;   MATCH-ANALYSIS;
PHYSIOLOGICAL-STRESS; FATIGUE-
SH: (576127) SOCCER PHYSIOLOGY

AB: The aim of this study was to assess physical fitness, match performance and development of fatigue during competitive matches at two high standards of professional soccer. Computerized time-motion analyses were performed 2-7 times during the competitive season on 18 top-class and 24 moderate professional soccer players. In addition, the players performed the Yo-Yo intermittent recovery test. The top-class players performed 28 and 58 % more (P < 0.05) high-intensity running and sprinting, respectively, than the moderate players (2.43 0.14 vs 1.90 0.12 km and 0.65 0.06 vs 0.41 0.03 km, respectively). The top-class players were better (11 %; P < 0.05) on the Yo-Yo intermittent recovery test than the moderate players (2.26 0.08 vs 2.04 0.06 km, respectively). The amount of high-intensity running, independent of competitive standard and playing position, was lower (35-45 %; P < 0.05) in the last than in the first 15 min of the game. After the 5-min period during which the amount of high-intensity running peaked, performance was reduced (P < 0.05) by 12 % in the following 5 min compared with the game average. Substitute players (n = 13) covered 25 % more (P < 0.05) ground during the final 15 min of high-intensity running than the other players. The coefficient of variation in high-intensity running was 9.2 % between successive matches, whereas it was 24.8 % between different stages of the season. Total distance covered and the distance covered in high-intensity running were higher (P < 0.05) for midfield players, full-backs and attackers than for defenders. Attackers and full-backs covered a greater (P < 0.05) distance in sprinting than midfield players and defenders. The midfield players and full-backs covered a greater (P < 0.05) distance than attackers and defenders in the Yo-Yo intermittent recovery test (2.23 0.10 and 2.21 0.04 vs 1.99 0.11 and 1.91 0.12 km, respectively). The results show that: (1) topclass soccer players performed more high-intensity running during a game and were better at the Yo-Yo test than moderate professional players; (2) fatigue occurred towards the end of matches as well as temporarily during the game, independently of competitive standard and of team position; (3) defenders covered a shorter distance in high-intensity running than players in other playing positions; (4) defenders and attackers had a poorer Yo-Yo intermittent recovery test performance than midfielders and full-backs; and (5) large seasonal changes were observed in physical performance during matches.
ITSH: (576127) CALCIO FISIOLOGIA

TI: Early phase differential effects of slow and fast barbell squat training

AU: Morrissey,-M-C; Harman,-E-A; Frykman,-P-N; Han,-K-H
SO: American-journal-of-sports-medicine-(Waltham,-Mass.) 26(2), Mar/Apr 1998, 221-230, Total No. of Pages: 10
PY: 1998
LE: Advanced
DE: BIOMECHANICS-; COMPARATIVE-STUDY; TIME-FACTOR; STRENGTH-; SQUAT-; WEIGHT-TRAINING
SH: (902920) TRAINING-METHODS-STRENGTH-TRAINING; (758312) WEIGHTLIFTING-AND-BOD TRAINING-AND-CONDITIONING
AB: To examine the importance of resistance training movement speed, two groups of women (24 plus/minus 4 years, 162 plus/minus 5 cm, 59 plus/minus 7 kg) squatted repeatedly at 1) 2 seconds up, 2 seconds down (slow, N = 11); or 2)

1 second up, 1 second down (fast, N = 10), doing three warm-up sets and three eight-repetition maximum sets, three times per week for 7 weeks. Tests included force platform and video analysis of the vertical jump, long jump, and maximum squat, and isometric and isokinetic knee extensor testing at speeds from 25 to 125 deg/sec. The groups improved similarly in many variables with training but also showed some differences. In the long jump, the fast group was superior in numerous variables including knee peak velocity and total-body vertical and absolute power. In the vertical jump, fast training affected the ankle and hip more (e.g., average power), and slow training mostly affected the knee (average torque). In isokinetic testing, the fast group improved strength most at the faster velocities, while the slow group strength changes were consistent across the velocities tested. Although both slow and fast training improved performance, faster training showed some advantages in quantity and magnitude of training effects.
ITSH: (902920) METODI-DI-ALLENAMENTO-PER-ATLETI-AGONISTI-ALLENAMENTO-ISOCINETICO-ISOMETRICO-ISOTONICO; (758312) SOLLEVAMENTO-PESI-E-CULTURA-FISICA ALLENAMENTO-E-CONDIZIONAMENTO
CL: RC1200 #661
SX: This document is available via SIRCExpress Order Number 462930, https://secure.sportquest.com/su.cfm?articleno=462930&title=462930

TI: Analiza aktwnosci siatkarzy w realizacji wyroznionych dzialan w grze

TI: The analysis of volleyball players' activity in the execution of specified actions in a game

AU: Mroczek,-D
SO: Czlowiek-i-ruch-(Wroclaw,-Poland) 3(1 Suppl 1), 2001, 84-87, Total No. of Pages: 4
PY: 2001
LE: Advanced
DE: VOLLEYBALL-; INDIVIDUAL-DIFFERENCE; GROUP-COHESION; ROLE-; OLYMPIC-GAMES,-SYDNEY-2000; TRIALS-; ACTION-; VIDEOTAPE-; MATCH-ANALYSIS; COMPUTER-PROGRAM
SH: (588310) VOLLEYBALL TESTING-AND-EVALUATION
AB: In the article, an analysis and assessment of sportsmen's activity according to created rates are presented. The purpose of the research was an evaluation of the players' activity in individual and team operation and also an evaluation of specified tasks realization in a game on a given level of sports skills. This research was carried out during the qualifications for the Olympic Games Sydney 2000. Collected data were analyzed by computer machines. The output data enabled us to come to some interesting conclusions concerning players' participation in specified action realization, depending on their role in a game.
ITSH: (588310) PALLAVOLO TEST
CL: QP302 P4 #320
SX: This document is available via SIRCExpress Order Number S-923179, https://secure.sportquest.com/su.cfm?articleno=S-923179&title=S-923179

TI: Soccer: from match taping to analysis

AU: Muresan,-E; Geerits,-J; De-Moor,-B
PB: In Cohen, G. (ed.), University of Technology, Sydney, Proceedings of the Sixth Australian Conference on Mathematics and Computers in Sport, Sydney, University of Technology, 2002, p.188-195, Total No. of Pages: 8
CN: Mathematics and Computers in Sport (6th : 2002 : Bond University, Qld.)
PY: 2002
LE: Advanced
DE: SOCCER-; MATCH-ANALYSIS; COMPUTER-PROGRAM; TEAM-POSITION; VIDEOTAPE-; VISUAL-FEEDBACK
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576045) SOCCER COACHING
AB: Soccer game analysis has so far been done only by watching the recording of the game and making remarks about the interesting elements in it. There is no exact data to use, let alone detailed and quantitative analysis of player and team performances and tactics. This paper proposes a different approach to match analysis, using cameras and computers to extract player coordinates throughout the whole match. Once we have the coordinates database, any statistics can be inferred, e.g. on individual player performance (position, speed, acceleration, field coverage, etc) as well as on team tactics (player complementarity, cohesion, field coverage, etc.).
ITSH: (576310) CALCIO TEST; (576045) CALCIO ALLENAMENTO

TI: Video analysis in sports: Videocoach

AU: Muresan,-E; Geerits,-J; De-Moor,-B
PB: In Cohen, G. (ed.), University of Technology, Sydney, Proceedings of the Sixth Australian Conference on Mathematics and Computers in Sport, Sydney, University of Technology, 2002, p.196-201, Total No. of Pages: 6
CN: Mathematics and Computers in Sport (6th : 2002 : Bond University, Qld.)
PY: 2002
LE: Advanced
DE: STATISTICS-; SOCCER-; MATCH-ANALYSIS; COMPUTER-PROGRAM; VIDEOTAPE-; VISUAL-FEEDBACK
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576045) SOCCER COACHING
AB: The traditional way of analysing soccer matches by coaches or whoever is interested in getting statistics about them, is to take notes on a piece of paper or to make remarks about what happens while watching the game. This paper proposes a different approach to match analysis utilising computers and the appropriate software tools. VideoCoach allows the user to annotate the match through easy-to-use interfaces. The annotations are saved in a database. Match analysis and statistics are automatically generated retrieved from the annotation database, video compilations can be made and analysis done. This kind of analysis is not strictly bound to soccer, but the examples will be from this sport.
ITSH: (576310) CALCIO TEST; (576045) CALCIO ALLENAMENTO

TI: Biomechanical changes in a professional baseball pitcher : early vs. late innings

AU: Murray,-T; Werner,-S; Hawkins,-R
CA: International-Society-of-Biomechanics-in-Sports
PB: In, Sanders, R.H. and Gibson, B.J. (eds.), Scientific proceedings : ISBS '99 : XVII International Symposium on Biomechanics in Sports, June 30-July 6, 1999, Edith Cowan University, Perth, Western Australia, Perth School of Biomedical and Sports Science, Edith Cowan University, 1999, p.305-307, Total No. of Pages: 3
CN: International Symposium on Biomechanics in Sports (17th : 1999 : Perth, Western Australia).
PY: 1999
LE: Advanced
DE: BASEBALL-; PITCHING-; BIOMECHANICS-; MATCH-ANALYSIS
SH: (544027) BASEBALL BIOMECHANICS
ITSH: (544027) BASEBALL BIOMECANICA
CL: QP302 #34970
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-162138, https://secure.sportquest.com/su.cfm?articleno=S-162138&title=S-162138

TI: Effects of arch height of the foot on ground reaction forces in running

     (Effet de la hauteur de la voute plantaire sur la force de reaction du sol en course.)
AU: Nachbauer,-W; Nigg,-B-M
SO: Medicine-and-science-in-sports-and-exercise-(Baltimore,-Md.) 24(11), Nov 1992, 1264-1269, Total No. of Pages: 6
PY: 1992
LE: Advanced
DE: ARCH-; FOOT-; RUNNING-; GROUND-REACTION-FORCE; SHOCK-ABSORPTION
SH: (728027) RUNNING BIOMECHANICS
AB: There is a suggested link between running injuries and arch type of the foot. However, a distinct cause and effect relationship has not been established. Feet may be functionally categorized on the basis of arch height. The purpose of this study was to compare selected ground reaction force variables in running for different arch heights. Static height of the medial longitudinal arch was measured using a caliper, arch flattening during running was determined by video analysis, and ground reaction forces during running were recorded from a KISTLER force plate. Thirty-four subjects were

divided into three arch height and three arch flattening groups, and single-factor analyses of variance were conducted to compare the groups. Arch height and arch flattening were not found to be significantly related. However, the initial medial force peak in the low arch group occurred significantly later than in the normal and high arch groups, and the anterior force peak in the low flattening group was lower compared with the medium and high flattening groups. Both arch measurements were ineffective in accounting for the observed variability in the ground reaction forces in running. Specifically, the impact forces did not differ for the different arch height and arch lowering groups.
ITSH: (728027) CORSA BIOMECANICA
CL: RC1200 #820
SX: This document is available via SIRCExpress Order Number 342113, https://secure.sportquest.com/su.cfm?articleno=342113&title=342113

Record 184 of 281 - SPORT Discus

TI: Statistical methods for analysing discrete and categorical data recorded in performance analysis

(Methodes statistiques pour l' analyse discrete et par categories des donnees rassemblees pour l' analyse de la performance.)
AU: Nevill,-A-M; Atkinson,-G; Hughes,-M-D; Cooper,-S-M
SO: Journal-of-sports-sciences-(London) 20(10), Oct 2002, 829-844, Total No. of Pages: 16
PY: 2002
LE: Advanced
DE: SPORT-; SOCCER-; SQUASH-RACQUETS; BIOMECHANICS-; SKILL-; MATCH-ANALYSIS; STATISTICS-
SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS
AB: In this paper, we identify appropriate statistical methods for analyzing categorical differences in discrete variables or `performance indicators' resulting from performance analysis. The random mechanisms associated with discrete events do not follow a normal distribution; that is, the normal distribution is a continuous not a discrete probability distribution. We propose appropriate statistical methods based on two key discrete probability distributions, the Poisson and binomial distributions. Two approaches are proposed and compared using examples from notational analysis. The first approach is based on the classic chi-square test of significance (both the goodness-of-fit test and the test of independence). The second approach adopts a more contemporary method based on log-linear and logit models fitted using the statistical software GLIM. Provided relatively simple one-way and two-way comparisons in categorical data are required, both of these approaches result in very similar conclusions. However, as soon as more complex models or higher-order comparisons are required, the approach based on log-linear and logit models is shown to be more effective. Indeed, when investigating those factors and categorical differences associated with binomial or binary response variables, such as the proportion of winners when attempting decisive shots in squash or the proportion of goals scored from all shots in association football, logit models become the only realistic method available. By applying log-linear and logit models to discrete events resulting from notational analysis, greater insight into the underlying mechanisms associated with sport performance can be achieved.
ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-847012, https://secure.sportquest.com/su.cfm?articleno=S-847012&title=S-847012

Record 185 of 281 - SPORT Discus

TI: Accuracy of qualitative analysis for assessment of skilled baseball pitching technique

AU: Nicholls,-R; Fleisig,-G; Elliott,-B; Lyman,-S; Osinski,-E
SO: Sports-biomechanics-(Edinburgh) 2(2), July 2003, 213-226, Total No. of Pages: 14
PY: 2003
LE: Advanced
DE: BASEBALL-; PITCHING-; BIOMECHANICS-; TECHNIQUE-; VIDEOTAPING-; METHOD-; EVALUATION-; ACCURACY-; DESIGN-; KINEMATICS-; MAN-
SH: (544027) BASEBALL BIOMECHANICS; (946700) BIOMECHANICS-SKILLS-ANALYSIS
AB: Baseball pitching must be performed with correct technique if injuries are to be avoided and performance maximised. High-speed video analysis is accepted as the most accurate and objective method for evaluation of baseball

pitching mechanics. The aim of this research was to develop an equivalent qualitative analysis method for use with standard video equipment. A qualitative analysis protocol (QAP) was developed for 24 kinematic variables identified as important to pitching performance. Twenty male baseball pitchers were videotaped using 60 Hz camcorders, and their technique evaluated using the QAP, by two independent raters. Each pitcher was also assessed using a 6-camera 200 Hz Motion Analysis system (MAS). Four QAP variables (22 %) showed significant similarity with MAS results. Inter-rater reliability showed agreement on 33 % of QAP variables. It was concluded that a complete and accurate profile of an athlete's pitching mechanics cannot be made using the QAP in its current form, but it is possible such simple forms of biomechanical analysis could yield accurate results before 3-D methods become obligatory.
ITSH: (544027) BASEBALL BIOMECANICA; (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA
CL: QP302.P4 #300
SX: This document is available via SIRCExpress Order Number S-925341, https://secure.sportquest.com/su.cfm?articleno=S-925341&title=S-925341

Record 186 of 281 - SPORT Discus

TI: The evolution of Australian football

AU: Norton,-K-I; Craig,-N-P; Olds,-T-S
SO: Journal-of-science-and-medicine-in-sport-(Belconnen,-A.C.T.) 2(4), Dec 1999, 389-404, Total No. of Pages: 16
PY: 1999
LE: Intermediate
DE: AUSTRALIAN-FOOTBALL; MATCH-ANALYSIS; VIDEOTAPE-; COMPARATIVE-STUDY; STATISTICS-; SPEED-; ELITE-ATHLETE
SH: (542177) AUSTRALIAN-FOOTBALL STATISTICS-AND-RECORDS
AB: Australian football has undergone considerable change over the past century. This evolution seems to have accelerated more recently since the introduction and major influence of the media, increased professionalism and the start of a national competition. In this study we have attempted to quantify the evolution in game 'style' by measuring events during elite football games (from video analysis) and gathering physical information on players involved at the highest level. These data are important to gain insight into the game demands so that player preparation may be enhanced and when predicting the nature of the game in the future. Understanding the patterns of play within the game may also be useful when assessing the possible impact of rule changes, for example, increasing the number of interchange players on the potential for injury. Four games were selected, one from each of the past 4 decades to determine the rate at which specific, measurable events occurred in the games. Height and mass data on players were also obtained from official records of registered players in the VFL/AFL competitions. The results indicate the 'speed' of the game has approximately doubled in the period 1961 - 1997. The proportion of the total game which involves 'play' time has been reduced significantly while breaks in play are more frequent and longer. Despite this pattern, however, the average game tempo has increased along with player height and mass and we present a case which suggests these are likely determinants of the increased incidence of player injuries and lost match time.
ITSH: (542177) FOOTBALL-AUSTRALIANO STATISTICA
CL: RC1200 #2600
SX: This document is available via SIRCExpress Order Number S-165081, https://secure.sportquest.com/su.cfm?articleno=S-165081&title=S-165081

Record 187 of 281 - SPORT Discus

TI: Time-motion analysis of elite touch players

AU: O'-Connor,-D
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.126-131, Total No. of Pages: 6
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: TOUCH-FOOTBALL; AUSTRALIA-; MATCH-ANALYSIS; STATISTICS-; HEART-RATE; LACTATE-
SH: (586310) TOUCH-FOOTBALL TESTING-AND-EVALUATION
ITSH: (586310) TOUCH-FOOTBALL TEST

Record 188 of 281 - SPORT Discus

TI: A Notational analysis of time factors of elite men's and ladies' singles tennis on clay and grass surfaces (Systeme d' analyse des facteurs de temps lors de simples feminins et masculins de tennis de haut-niveau sur terre battue ou gazon)

AU: O'-Donoghe-P/-Liddle-D
SO: Science and racket sports II : proceedings of the second world congress of science and racket sports and fifth international table tennis federation sports science congress, 22-25 April 1997 / Ed. by A. Lees, M. Hughes, I. Maynard,...[et al].- Londres : Spon, 1998 ROYAUME UNI, pp 241-246, 6 p., Notes bibliogr. p 246
PY: 1998
LE: Advanced

Record 189 of 281 - SPORT Discus

TI: Time-motion analysis of FA Premier League soccer competition. (Abstract)

(Analyse des rythmes de travail lors de la competition de premiere division FA de football.) (Resume)
AU: O'-Donoghue,-P-G; Parker,-D
SO: Journal-of-sports-sciences-(London) 20(1), Jan 2002, 26, Total No. of Pages: 1
CN: Annual Conference of the British Association of sport and Exercise Sciences (BASES) (2001 : Newport, Wales).
PY: 2001
LE: Advanced
DE: SOCCER-; ELITE-ATHLETE; MATCH-ANALYSIS; COMPETITION-; TIME-FACTOR; AEROBIC-CAPACITY; REST-; MEASUREMENT-; FA-PREMIER-LEAGUE
SH: (576127) SOCCER PHYSIOLOGY
ITSH: (576127) CALCIO FISIOLOGIA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-848786, https://secure.sportquest.com/su.cfm?articleno=S-848786&title=S-848786

Record 190 of 281 - SPORT Discus

TI: A notational analysis of elite tennis strategy

(Analyse, a partir des resultats, de la strategie des joueurs de tennis de haut niveau.)
AU: O'-Donoghue,-P; Ingram,-B
SO: Journal-of-sports-sciences-(London) 19(2), Feb 2001, 107-115, Total No. of Pages: 9
PY: 2001
LE: Advanced
DE: TENNIS-; EVALUATION-; NOTATION-; STRATEGY-; ELITE-ATHLETE; SEX-FACTOR; SURFACE-; COMPARATIVE-STUDY
SH: (708180) TENNIS STRATEGY; (708078) TENNIS FACILITIES
AB: A notational analysis of singles events at all four Grand Slam tournaments between 1997 and 1999 was conducted to determine the influence of the sex of the player and court surface on elite tennis strategy. Rallies of 7.1 2.0 s in women's singles were significantly longer than those in men's singles (5.2 1.8 s; P < 0.001). Rallies of 6.3 1.8 s at the Australian Open, 7.7 1.7 s at the French Open, 4.3 1.6 s at Wimbledon and 5.8 1.9 s at the US Open were recorded. Rallies were significantly longer at the French Open than at any other tournament (P < 0.05) and significantly shorter at Wimbledon than at any other tournament (P < 0.05). In women's singles, 52.8 12.4 % of points were baseline rallies, significantly more than in men's singles (28.6 19 %; P < 0.001). The proportion of baseline rallies played at the French Open (51.9 14.2 % of points) was significantly greater than at the Australian Open (46.6 12.5 %), Wimbledon (19.7 19.4 %) and the US Open (35.4 19.5 %; P < 0.05). The results show that both the sex of the player and surface of the court have a significant influence on the nature of singles tennis at Grand Slam tournaments.
ITSH: (708180) TENNIS TATTICA; (708078) TENNIS IMPIANTI
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-671982, https://secure.sportquest.com/su.cfm?articleno=S-671982&title=S-671982

Record 191 of 281 - SPORT Discus

TI: A match analysis of elite tennis strategy for ladies' singles on clay and grass surfaces

AU: O'-Donoghue,-P; Liddle,-D

PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 247-253, Total No. of Pages: 7

CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).

PY: 1998

LE: Advanced

DE: MATCH-ANALYSIS; ELITE-ATHLETE; WOMAN-; SINGLES-; TENNIS-; CLAY-; GRASS-; STRATEGY-; NOTATION-

SH: (708398) TENNIS WOMEN; (708310) TENNIS TESTING-AND-EVALUATION; (708180) TENNIS STRATEGY

ITSH: (708398) TENNIS DONNE; (708310) TENNIS TEST; (708180) TENNIS TATTICA

CL: GV990 #34134

SX: This document is available via SIRCExpress Order Number 480697, https://secure.sportquest.com/su.cfm?articleno=480697&title=480697

Record 192 of 281 - SPORT Discus

TI: A notational analysis of time factors of elite men's and ladies' singles tennis on clay and grass surfaces

AU: O'-Donoghue,-P; Liddle,-D

PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 241-246, Total No. of Pages: 6

CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).

PY: 1998

LE: Advanced

DE: NOTATION-; TIME-FACTOR; ELITE-ATHLETE; MAN-; WOMAN-; SINGLES-; TENNIS-; CLAY-; GRASS-; BALL-

SH: (708310) TENNIS TESTING-AND-EVALUATION

ITSH: (708310) TENNIS TEST

CL: GV990 #34134

SX: This document is available via SIRCExpress Order Number 480696, https://secure.sportquest.com/su.cfm?articleno=480696&title=480696

Record 193 of 281 - SPORT Discus

TI: Application of an analysis system evaluating intermittent activity during a soccer match

AU: Ohashi,-J; Miyaki,-O; Nagahama,-H; Ogushi,-T; Ohashi,-K

PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.132-136, Total No. of Pages: 5

CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).

PY: 2002

LE: Advanced

DE: SOCCER-; MATCH-ANALYSIS; STATISTICS-; MOVEMENT-

SH: (576310) SOCCER TESTING-AND-EVALUATION

ITSH: (576310) CALCIO TEST

Record 194 of 281 - SPORT Discus

TI: Evaluation of the offensive behavior of elite soccer teams

AU: Papadimitriou,-K; Aggeloussis,-N; Derri,-V; Michalopoulou,-M; Papas,-M

SO: Perceptual-and-motor-skills-(Missoula,-Mont.) 93(2), Oct 2001, 405-415, Total No. of Pages: 11

PY: 2001

LE: Advanced
DE: EVALUATION-STUDY; MATCH-ANALYSIS; WORLD-CHAMPIONSHIP; SOCCER-; ELITE-ATHLETE; OFFENCE-; FRANCE-; HOLLAND-; CROATIA-; BRAZIL-
SH: (576189) SOCCER STRATEGY-OFFENSIVE
AB: The purpose of the present study was to evaluate the offensive behavior of the four elite teams (France, Brazil, Croatia, and Holland) using data from the semifinals of the 18th World Soccer Championship in France in 1998. 28 videotaped soccer games were observed, 7 for each team. The protocol contained the following parameters of evaluation: (a) successful pass in the defensive and middle area, (b) unsuccessful pass in the defensive and middle area, (c) attempt on goal in the offensive area, and (d) cross and follow-up action. A multivariate analysis of variance showed the teams' plan was significantly different only in playing the ball back to the goalkeeper. This last action, used more often by Holland than by the other teams, indicated its restrained offensive behavior, which may be one of the reasons for its defeat in some games.
ITSH: (576189) CALCIO TATTICA-ATTACCO
CL: BF1 P4 #100
SX: This document is available via SIRCExpress Order Number S-801387, https://secure.sportquest.com/su.cfm?articleno=S-801387&title=S-801387

Record 195 of 281 - SPORT Discus

TI: Competitive characteristics of the center player in basketball during the initiation of his action with the ball

AU: Papadimitriou,-K; Taxildaris,-K
SO: Exercise-and-society-journal-of-sport-science-(Komotini) (24), 2000, 57-67, Total No. of Pages: 11
PY: 2000
LE: Advanced
DE: BASKETBALL-; CENTRE-; BALL-CONTROL; EVALUATION-; COMPETITIVE-BEHAVIOUR; COMPARATIVE-STUDY; SEGMENTAL-ANALYSIS-TECHNIQUE; VIDEOTAPE-
SH: (546147) BASKETBALL PSYCHOLOGY
AB: The purpose of the present study was the evaluation of the competing behavior (with ball) of the center player. Seventy center players from 22 teams (three competitive levels) were observed. The evaluation parameters were a) way of ball possession b) way of ball reception, and c) execution area of the above actions. A Video Analysis program (Vicas) was used to analyze the center players during 46 basketball games. According to the results, there were three factors characterizing center players' initiation actions. These factors refer to a) the organized structure of these offensive actions with the ball and b) the center's dynamic contribution to the ball possession during defensive and offensive play. Based on the characteristics of each group it seems that the center players' competitive behavior varies according to their competitive level.
ITSH: (546147) PALLACANESTRO PSICOLOGIA
CL: GV701.P4 #1800
SX: This document is available via SIRCExpress Order Number S-657711, https://secure.sportquest.com/su.cfm?articleno=S-657711&title=S-657711

Record 196 of 281 - SPORT Discus

TI: Are content and competencies enough? Strategies to encourage reflective practice among athletic-training students

AU: Parker,-J; Pitney,-W
SO: JOPERD-The-journal-of-physical-education,-recreation-and-dance-(Reston,-VA) 74(2), Feb 2003, 46-50, Total No. of Pages: 5
PY: 2003
LE: Advanced
DE: ATHLETIC-TRAINING; ATHLETIC-TRAINER; STUDENT-; LEARNING-; SELF-EVALUATION; VIDEOTAPING-
SH: (953600) ATHLETIC-TRAINING-PROFESSIONAL-PREPARATION
AB: Reports on strategies that were employed to encourage reflective practice among athletic training students. Reports on three clinical education course strategies - video analysis, reflective journal keeping and expanded self-evaluation procedures. Includes tables.
ITSH: (953600) PREPARATORE-ATLETICO-PREPARAZIONE-PROFESSIONALE

TI: An analysis of team statistics in Australian rules football

AU: Patterson,-A
PB: In, Mathematics and computers in sport: a conference held at Bond University, Queensland, Australia 13th to 15th
July 1998, [Queensland], [Bond University], 1998, p.237-244
CN: Mathematics and Computers in Sport (4th : 1998 : Queensland)
PY: 1998
LE: Intermediate
DE: AUSTRALIAN-FOOTBALL; ELITE-ATHLETE; STATISTICS-; MATCH-ANALYSIS
SH: (542177) AUSTRALIAN-FOOTBALL STATISTICS-AND-RECORDS
ITSH: (542177) FOOTBALL-AUSTRALIANO STATISTICA

TI: Aspekte unkonventioneller Modellbildung und deren exemplarische Anwendungsmoeglichkeiten in der
Sportwissenschaft
      (Des aspects de la construction de modeles peu conventionnels et de leur application exemplaire en
science sportive.)

TI: Aspects of unconventional model formation and exemplary possibilities of their application in sports science

AU: Perl,-J
SO: Sportwissenschaft-(Schorndorf) 31(3), Sept 2001, 282-301, Total No. of Pages: 20
PY: 2001
LE: Advanced
DE: THEORETICAL-MODEL; MATHEMATICAL-MODEL; COMPUTER-; EVALUATION-; TRAINING-; MATCH-
ANALYSIS; LEARNING-
SH: (900970) COACHING-COMPUTER-APPLICATIONS; (992300) RESEARCH-AND-RESEARCH-METHODS-
RESEARCH-METHODS
AB: The increase of the performance capability of desk-top computers together with the development of
unconventional paradigms of model formation offers new possibilities of problem solving. In the introduction of this article
the by now widely known new paradigms of Fuzzy Logic, Genetic Algorithms and Neuronal Networks are briefly
presented. After that, two examples from the current research work are used to show how specific forms of models and
unconventional paradigms can supplement one another when developing problem solutions. In the first example the
interaction of load and performance is analyzed at an abstract level with the aid of a non-interpreted Level-Rate Model,
and a Genetic Algorithm is used for the optimization of the load profile. The second example deals with the problem of
capturing and analyzing complex playing processes. In this context the use of Neuronal Networks is presented and the
possible interaction with methods of Fuzzy Logic is discussed. Finally a current result is briefly dealt with. This result
shows how the two outlined approaches can be combined to a dynamic model of continuous learning processes.
ITSH: (900970) ALLENAMENTO-APPLICAZIONI-INFORMATICHE; (992300)
CL: GV701.P4 #1000
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-797012,
https://secure.sportquest.com/su.cfm?articleno=S-797012&title=S-797012

TI: Anwendung der EDV in Sportmedizin und Sportwissenschaft: Entwicklung und Perspektiven
      (Utilisation du traitement electronique des donnees en medecine du sport et en science du sport:
developpement et perspectives.)

TI: Electronic data processing in sport medicine and sport sciences

AU: Perl,-J
SO: Deutsche-Zeitschrift-fuer-Sportmedizin-(Cologne) 49(11 Suppl), Oct 1998, 322-326, Total No. of Pages: 5
CN: Deutscher Sportaerztekongress (35. : 1997 : Tuebingen).
PY: 1997
LE: Intermediate
DE: SPORTS-MEDICINE; SPORTS-SCIENCE; TECHNOLOGY-; DATA-PROCESSING
SH: (927000) SPORTS-SCIENCE; (911540) INFORMATION-PROCESSING-DATA-PROCESSING
AB: "Electronic Data Processing" was coined in the early fifties and refers to the very first electronic calculators. Even nowadays it is used as a synonym for all activities in the field of computer aided information handling. However, the variety of data processing techniques has been developing during the last thirty years. Currently, the area of media and communication networks are becoming more and more important. With regard to the rising demand for complex and manyfold information, concepts and techniques of information processing have been changing, too. So, digital video, computer aided video analysis, pattern recognition, and in particular unconventional paradigms of modelling span a wide range of potentiality and challenges, which are of special interest for sport medicine and sport sciences.
ITSH: (927000) CIENCIAS-DEL-DEPORTE; (911540) TRATTAMENTO-DELL'INFORMAZIONE-ELABORAZIONE-DATI
CL: RC1200 #422
SX: This document is available via SIRCExpress Order Number S-22744, https://secure.sportquest.com/su.cfm?articleno=S-22744&title=S-22744

Record 200 of 281 - SPORT Discus

TI: Analisis de la dimension tiempo en futbol

TI: Analysis of the time dimension in soccer

AU: Pino-Ortega,-J
SO: Lecturas:-educacion-fisica-y-deportes-(Buenos-Aires) 8(45), Feb 2002
URL: http://www.efdeportes.com/efd45/tiempo.htm
PY: 2002
LE: Intermediate
DE: SOCCER-; TIME-FACTOR; MATCH-ANALYSIS
SH: (576003) SOCCER GENERAL WORKS
ITSH: (576003) CALCIO GENERALITA

Record 201 of 281 - SPORT Discus

TI: Can a tennis player increase the probability of winning a point when it is more important?

AU: Pollard,-G
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.253-256, Total No. of Pages: 4
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: TENNIS-; STRATEGY-; MATCH-ANALYSIS; MATHEMATICAL-MODEL; STATISTICS-; ANALYSIS-OF-VARIANCE
SH: (708180) TENNIS STRATEGY
AB: The benefit a player can receive by "lifting his/her play" on the more important points is well known. Is there any evidence, however, that some players can lift their play on particular points? In this paper we analyse some situations in which a particular highly ranked player may wish to lift his play, and conclude that there is some evidence that he can do so.
ITSH: (708180) TENNIS TATTICA

Record 202 of 281 - SPORT Discus

TI: Measuring the effectiveness of playing strategies at soccer

AU: Pollard,-R; Reep,-C
SO: Statistician- 46(4), 1997, 541-550, Total No. of Pages: 10
PY: 1997
LE: Advanced
DE: SOCCER-; STRATEGY-; EVALUATION-; MATCH-ANALYSIS; REGRESSION-ANALYSIS
SH: (576310) SOCCER TESTING-AND-EVALUATION; (576177) SOCCER STATISTICS-AND-RECORDS; (576180) SOCCER STRATEGY; (A72200) RESEARCH-AND-RESEARCH-METHODS-STATISTICAL-ANALYSIS; (992300) RESEARCH-AND-RESEARCH-METHODS-RESEARCH-METHODS

AB: Using a notational system which records on-the-ball events taking place throughout a soccer match, the game can be broken down into a series of team possessions. To assess the effectiveness of a team possession, a quantitative variable is developed representing the probability of a goal being scored, minus the probability of one being conceded. This variable, called the yield, can be used to evaluate both the expected outcome of a team possession originating in a given situation, as well as the actual outcome of the possession. In this way, the effectiveness of different strategies occurring during the possession can be quantified and compared.

ITSH: (576310) CALCIO TEST; (576177) CALCIO STATISTICA; (576180) CALCIO TATTICA; (A72200) RICERCA-E-METODI-DI-RICERCA-ANALISI-STATISTICA; (992300)
SX: This   document   is   available   via   SIRCExpress   Order   Number   494502, https://secure.sportquest.com/su.cfm?articleno=494502&title=494502

Record 203 of 281 - SPORT Discus

TI: Uspesnost obrannej fazy hry druzstva na sieti v zavislosti od kvality podania vo vrcholovom volejbale muzov
   (Zusammenhaenge zwischen der Qualitaet des Blocks und des Aufschlags im Maenner-Volleyball der Weltklasse.)

TI: Success of defensive phase of team game at net in relationship to the quality of service in top men volleyball

AU: Pridal,-V
SO: TVS-telesna-vychova-and-sport-(Bratislava) 9(2), 1999, 17-20, Total No. of Pages: 4
PY: 1999
LE: Intermediate
DE: EVALUATION-STUDY; MATCH-ANALYSIS; VOLLEYBALL-; MAN-; ELITE-ATHLETE; BLOCKING-
SH: (588211) VOLLEYBALL TECHNIQUES-AND-SKILLS-BLOCKING

AB: The contribution gives the analysis of the influence of good quality of service to the success of follow-up defense of a team at the net from the point of view of the quality and a kind of block of the men team at the top international level. The work presents the evaluation of 535 interaction service - block. The relationship between the quality of service and the quality of block or second block was evaluated by chi-quadrate test. The results give some evidence that there exist significant relationship between good quality of service and defense of team at the net.

ITSH: (588211) PALLAVOLO TECNICO-BLOCCO
CL: GV701.P4 #1640
SX: This   document   is   available   via   SIRCExpress   Order   Number   S-658086, https://secure.sportquest.com/su.cfm?articleno=S-658086&title=S-658086

Record 204 of 281 - SPORT Discus

TI: Formation, System, Spielstil - wo liegt das Geheimnis des Erfolges? Ein Beitrag zur Spielstildebatte im Fussball
   (Formasjon system, spillestill - hvor ligger hemmeligheten til susess? - Et bidrag til spillestildebatten i fotball.)

TI: Formation, system, playing style - what are the secrets for the success? - A contribution to the debate about playing style in football

AB: A play that seems to be so simple and that fascinates a lot of people has expand to a world wide business. The value of football that entertains are often described by the terms effectiveness and attractiveness. Modern methods how to analyze the play has not discovered any "winning formula" in football. The ball is still round and the result of any match are still unpredictable. In the debate about winning teams the explanation for success like "the best system" or "an effective playing style" are used. Are these tactical terms the key to create success? We start in this article to discuss the terminology that are used and afterwards present the term of playing style with the theory of group sociology and the consequences for effective and attractive football. The results of the Norwegian National Team that in the nineties are based on developing an effective playing style make the starting-point for these reflections.

Record 205 of 281 - SPORT Discus

TI: Injury risk associated with playing actions during competitive soccer

(Etude des risques de blessures lies aux actions de jeu lors des rencontres de football.)

AB: To assess the exposure of players to injury risk during English Premier League soccer matches in relation to selected factors. Injury risk was assessed by rating the injury potential of playing actions during competition with respect to (a) type of playing action, (b) period of the game, (c) zone of the pitch, and (d) playing either at home or away. In all, 10 games from the English Premier League 1999-2000 were chosen for analysis. A notation system was used whereby 16 soccer specific playing actions were classified into three categories: those inducing actual injury, those with a potential for injury (graded as mild, moderate, or high), and those deemed to have no potential for injury. The pitch was divided into 18 zones, and the position of each event was recorded along with time elapsed in the game, enabling six 15 minute periods to be defined. Close to 18 000 actions were notated. On average (mean (SD)), 1788 (73) events (one every three seconds), 767 (99) events with injury potential (one every six seconds), and 2 (1) injuries (one every 45 minutes) per game were recorded. An overall injury incidence of 53 per 1000 playing hours was calculated. Receiving a tackle, receiving a "charge", and making a tackle were categorized as having a substantial injury risk, and goal catch, goal punch, kicking the ball, shot on goal, set kick, and heading the ball were all categorized as having a significant injury risk. All other actions were deemed low in risk. The first 15 minutes of each half contained the highest number of actions with mild injury potential, the last 15 minutes having the highest number of actions with moderate injury potential (p < 0.01). The first and last 15 minutes of the game had the highest number of actions with high injury potential, although not significant. More actions with mild injury potential occurred in the goal area, and more actions with moderate and high injury potential occurred in the zone adjacent to the goal area (p < 0.001). There was no significant difference between home and away with regard to injury potential. Playing actions with high injury risk were linked to contesting possession. Injury risk was highest in the first and last 15 minutes of the game, reflecting the intense engagements in the opening period and the possible effect of fatigue in the closing period. Injury risk was concentrated in the areas of the pitch where possession of the ball is most vigorously contested, which were specific attacking and defending zones close to the goal. Injury potential was no greater in away matches than at home.

ITSH: (576093) CALCIO INFORTUNI-E-INCIDENTI
CL: RC1200 #300
SX: This document is available via SIRCExpress Order Number S-854367, https://secure.sportquest.com/su.cfm?articleno=S-854367&title=S-854367

Record 206 of 281 - SPORT Discus

TI: Assessment of sports performance with particular reference to field games

AU: Reilly,-T
SO: European-journal-of-sport-science 1(3), Aug 2001
URL: http://www.humankinetics.com/products/journals/ejss_info.cfm
PY: 2001
LE: Intermediate
DE: TEAM-SPORT; ACHIEVEMENT-; SKILL-; EVALUATION-; MATCH-ANALYSIS; PHYSICAL-FITNESS; TESTING-; SIMULATION-; REVIEW-
SH: (540310) TEAM-SPORTS TESTING-AND-EVALUATION
AB: Objective data on performance of game players provide a useful basis for monitoring the contributions of individuals towards the team's collective efforts. Notation analysis and motion analysis are different methods of recording patterns of play- and work-rate of players, respectively. These types of observations yield profiles from which sport-specific tests may be designed. Examples are given from soccer, rugby football, and field hockey. The observations are also useful in the design of laboratory-based sports-specific protocols for the design of experimental work. With the rapidly evolving technologies of performance analysis, this area of work is likely to increase in future.
ITSH: (540310) SPORT-DI-SQUADRA TEST

Record 207 of 281 - SPORT Discus

TI: The effect of carbohydrate supplementation on the work-rate of Gaelic football players

AU: Reilly,-T; Keane,-S
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.234-238, Total No. of Pages: 5
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: GAELIC-FOOTBALL; CARBOHYDRATE-; DIETARY-SUPPLEMENTATION; MATCH-ANALYSIS; FATIGUE-
SH: (566114) GAELIC-FOOTBALL NUTRITION
ITSH: (566114) FOOTBALL-GAELICO NUTRIZIONE

Record 208 of 281 - SPORT Discus

TI: Science and soccer. 2nd ed

AU: Reilly,-T; Williams,-A-M
PB: London, Routledge, 2003, 332 p.
PY: 2003
LE: Advanced
DE: SOCCER-; SPORTS-SCIENCE; BIOMECHANICS-; SPORTS-MEDICINE
SH: (576026) SOCCER BIOLOGY; (576027) SOCCER BIOMECHANICS; (576111) SOCCER MEDICINE; (576147) SOCCER PSYCHOLOGY
AB: CONTENTS: [1] Introduction to science and soccer; Part One - Biology and soccer : [2] Functional anatomy; [3] Fitness assessment; [4] Physiology of training; [5] Motion analysis and physiological demands; [6] Nutrition; [7] Special Populations; Part Two - Biomechanics and soccer medicine : [8] Biomechanics applied to soccer skills; [9] The biomechanics of soccer surfaces and equipment; [10] Injury prevention and rehabilitation; [11] Psychology and injury; [12] Environmental stress; Part Three - Behavioural science and soccer : [13] Coaching science; [14] Skill acquisition; [15] Psychology; [16] Football and society; Part Four - Match analysis : [17] Notational analysis; [18] The science of

match analysis; [19] Information technology; Part Five - Growth and adolescence : [20] Growth and development; [21] Talent identification in football.

Fully revised and updated edition of the classic text, now includes new chapters on talent identification, growth and development of youth players and new research on female soccer players.
ITSH: (576026) CALCIO BIOLOGIA; (576027) CALCIO BIOMECANICA; (576111) CALCIO MEDICINA; (576147) CALCIO PSICOLOGIA

TI: Analyse des gruppentaktischen Angriffsverhaltens im Basketball auf der Grundlage einer prozessorientierten Modellbildung
(Basketball: analyse de la tactique offensive de groupe sur la base d' un modele.)

TI: Basketball: Analysis of the group-tactical offense behavior on the basis of a process-orientated model formation

AU: Remmert,-H
SO: Leistungssport-(Muenster) 33(6), Nov 2003, 3;23-29;63, Total No. of Pages: 9
PY: 2003
LE: Advanced
DE: BASKETBALL-; STRATEGY-; OFFENCE-; DEFENCE-; MATCH-ANALYSIS; THEORETICAL-MODEL; VIDEOTAPING-; COMPUTER-
SH: (546180) BASKETBALL STRATEGY
AB: The systematic match observation presented in this article deals with the basic questions whether the group-tactical decision behavior can be operationalized for the practice of observation and whether particularly successful interactions between the offense and defense can be identified within the group-tactical actions in top-level basketball.
ITSH: (546180) PALLACANESTRO TATTICA
CL: GV701 P4 #420
SX: This document is available via SIRCExpress Order Number S-964667, https://secure.sportquest.com/su.cfm?articleno=S-964667&title=S-964667

TI: Analyse der individual- und gruppentaktischen Angriffabschlusshandlungen im Damenbasketball mit Hilfe des interaktiven Videosystems VIDEO AS
(Analyse des actions finales, accomplies lors des attaques individuelles et en equipe en basket-ball des dames et enregistrees au moyen d' une video interactive (VIDEO AS).)

TI: Analysis of the individual and group-tactical final offensive actions in women's basketball using the VIDEO AS interactive video system

AU: Remmert,-H; Steinhoefer,-D
SO: Leistungssport-(Muenster) 28(6), Dec 1998, 47-51, Total No. of Pages: 5
PY: 1998
LE: Advanced
DE: BASKETBALL-; WOMAN-; STRATEGY-; MATCH-ANALYSIS; ELITE-ATHLETE
SH: (546192) BASKETBALL TECHNIQUES-AND-SKILLS; (546180) BASKETBALL STRATEGY
AB: While in elite basketball individual performance controls are no longer considered as something extraordinary, the examination of tactical connections is still based on the coach's subjective judgements to a great extent. The method of game observation for the analysis of final offensive actions presented in this article is a possibility to quantify the decision actions which are directly relevant to success on the tactical performances of individual players.
ITSH: (546192) PALLACANESTRO TECNICO; (546180) PALLACANESTRO TATTICA
CL: GV701.P4 #420
SX: This document is available via SIRCExpress Order Number S-79503, https://secure.sportquest.com/su.cfm?articleno=S-79503&title=S-79503

TI: An analysis and comparison of the tries scored in the 1998 five nations championship and the 1998 tri-nations series. (Abstract)

AU: Robinson,-D

PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.377, Total No. of Pages: 1

URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs377a.htm

CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)

PY: 2000

LE: Advanced

DE: RUGBY-UNION; MATCH-ANALYSIS; STATISTICS-; EVALUATION-; COMPETITION-

SH: (574177) RUGBY-UNION STATISTICS-AND-RECORDS

ITSH: (574177) RUGBY-UNION STATISTICA

The process of professionalisation in rugby union has involved significant financial investment in the game. Consequently, the nature of elite rugby as a spectacle is of great interest to broadcasters and sponsors as well as the games administrators. As such, an important aspect of play that can be examined is the number and nature of tries scored by teams at the elite level. Eight games from the 1998 Five Nations Championship and all six games of the 1998 Tri-Nations series were analysed. From this data, the following information was calculated:

· the number of tries scored and penalty goals attempted

· the phase of play in which teams tries were scored

· the time of the match in which a team tries were scored

· the percentage of total points each team scored as tries

The results of this study suggested that the most successful teams in the 1998 Five Nations Championship and Tri-Nations Series were those who scored the most tries and a higher percentage of total points as tries, perhaps indicative of an expansive playing style. However, in the Tri-Nations tournament, there were fewer tries scored per match and more penalty goal attempts and, in both competitions, a reliance on set play as the primary instrument for scoring tries. In light of the results of the 1999 Rugby World Cup, an analysis of the tries scored by teams in earlier Tri-Nations and Five Nations games might have predicted the style of play that would prove most successful in 1999

Record 212 of 281 - SPORT Discus

TI: Differences in situation-related indicators of the handball game in relation to the achieved competitive results of teams at 1999 world championship in Egypt

(Razlike u situacijskim pokazateljima rukometne igre u odnosu na rezultatsku uspjesnost momcadi na svjetskom prvenstvu u Egiptu 1999. godine.)

(Unterschiede in den situationsbezogenen Parametern des Handballspieles im Bezug auf die Wettkampfsergebnisse der Mannschaften auf der Weltmeisterschaft in Aegypten im Jahre 1999.)

AU: Rogulj,-N

SO: Kinesiology-(Zagreb) 32(2), Dec 2000, 63-74, Total No. of Pages: 12

PY: 2000

LE: Advanced

DE: EVALUATION-STUDY; MATCH-ANALYSIS; TEAM-HANDBALL; ELITE-ATHLETE; MAN-; WORLD-CHAMPIONSHIP; SKILL-; STRATEGY-

SH: (584180) TEAM-HANDBALL STRATEGY

AB: The purpose of the research was to determine the differences in the situation-related parameters of the game in relation to the results achieved or the performance of the teams in top quality handball for men. The differences in 27 situation-related indicators of the game, both on defence and on attack, have been analysed by means of the multivariate analysis of the variance. The sample consisted of 80 matches from the 1999 Men's World Championship in Egypt. These 27 performance indicators have been analysed in relation to the level of success or competitive successfulness which was determined by two classification factors: the first one was named general championship performance (general achievement in competition) and was defined by the teams' final ranking at the championship. The second one was named the performance in a match and was defined by a victory or defeat in a match. It has been established that the successful teams are predominantly efficient in: the efficient completion of the set attacks against an organized defence, the collective counter-attacks, the number of assistances, the penalty (seven meters) shots, and in individual actions of the break-through (on attack), while on defence they are more efficient in executing the non-contact elements of the defence and in the goalkeeper's situation-related successfulness on defence in the back court or long range shots saves. Less successful teams are predominant in turnovers, in attacks against the set defence and in shots taken from the back positions.

ITSH: (584180) PALLAMANO-DI-SQUADRA TATTICA

CL: QP302 P4 #220

SX: This document is available via SIRCExpress Order Number S-673031, https://secure.sportquest.com/su.cfm?articleno=S-673031&title=S-673031

Record 213 of 281 - SPORT Discus

TI: How does the direction of the goal throw influence the outcome of a team handball match?

AU: Rogulj,-N; Srhoj,-V

SO: Leistungssport-(Muenster) 33(1), Jan 2003, 50-53, Total No. of Pages: 4

PY: 2003

LE: Advanced

DE: EVALUATION-STUDY; MATCH-ANALYSIS; TEAM-HANDBALL; SHOOTING-; SKILL-; ELITE-ATHLETE; MAN-; WORLD-CHAMPIONSHIP

SH: (584192) TEAM-HANDBALL TECHNIQUES-AND-SKILLS; (584288) TEAM-HANDBALL TECHNIQUES-AND-SKILLS-SHOOTING

AB: So far only few studies have dealt with the analysis of differently placed goal throws. This gap in research shall be made smaller with this article. On the basis of the evaluation of 80 games during the last World Championships in team handball in Egypt 1999 the efficiency of the goal throws, their influence on the respective result of the game and the total success of the team as well as the effectiveness of the different playing positions is measured.

ITSH: (584192) PALLAMANO-DI-SQUADRA TECNICO; (584288) PALLAMANO-DI-SQUADRA TECNICO-TIRO

CL: GV701 P4 #420

SX: This document is available via SIRCExpress Order Number S-873341, https://secure.sportquest.com/su.cfm?articleno=S-873341&title=S-873341

Record 214 of 281 - SPORT Discus

TI: The effects of travel on team performance in the Australian Football League

AU: Rowbottom,-D-G; Pickering,-D-M

PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.536, Total No. of Pages: 1

URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs536a.htm

CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)

PY: 2000

LE: Advanced

DE: AUSTRALIAN-FOOTBALL; TRAVEL-; GAME-LOCATION; MATCH-ANALYSIS

SH: (542177) AUSTRALIAN-FOOTBALL STATISTICS-AND-RECORDS

ITSH: (542177) FOOTBALL-AUSTRALIANO STATISTICA

TI: Isokinetic strength related to jumping but not kicking performance of Australian footballers

(Force isocinetique relative au saut vertical et non a la performance du coup de pied chez les footballeurs australiens.)

AU: Saliba,-L; Hrysomalils,-C

SO: Journal-of-science-and-medicine-in-sport-(Belconnen,-A.C.T.) 4(3), Sept 2001, 336-347, Total No. of Pages: 12

PY: 2001

LE: Advanced

DE: AUSTRALIAN-FOOTBALL; ISOKINETIC-; STRENGTH-; SKILL-; KICKING-; VERTICAL-JUMP; KNEE-

SH: (542132) AUSTRALIAN-FOOTBALL PHYSIOLOGY-MUSCLE; (542192) AUSTRALIAN-FOOTBALL TECHNIQUES-AND-SKILLS

AB: The relationships between lower limb strength and two Australian football (AF) skills were assessed for 19 sub-elite AF players. Knee extension (KE) and knee flexion (KF) strength were assessed using a Biodex isokinetic dynomometer at angular velocities of 60, 240 and 360 degrees/sec. The two AF skills evaluated were running vertical jump (VJ) and kicking performance (KP). VJ performance was defined as the maximal jump height measured with a Yardstick device. KP was gauged through video analysis, as the post-contact resultant ball velocity (BV) during maximal effort drop punt kicking. Strength was measured as the isokinetic peak torque (PT) value. No significant correlations were detected between the isokinetic knee strength values and maximal kicking velocity. Low to moderate significant correlations (r=0.55-0.69, p<0.05) were detected between the isokinetic measures and VJ height. It may be inferred that additional strengthening of the knee musculature may enhance running VJ performance, but not nessarily kicking velocity for this group of sub-elite AF players.

ITSH: (542132) FOOTBALL-AUSTRALIANO FISIOLOGIA-MUSCOLO; (542192) FOOTBALL-AUSTRALIANO TECNICO

CL: RC1200 #2600

SX: This document is available via SIRCExpress Order Number S-799148, https://secure.sportquest.com/su.cfm?articleno=S-799148&title=S-799148

TI: Uma caminhada metodologica na rota das estatisticas e da analise do jogo de Basquetebol

TI: A methodological stroll on the road of statistics and game analysis in basketball

AU: Sampaio,-J; Janeira,-M

SO: Lecturas:-educacion-fisica-y-deportes-(Buenos-Aires) 7(39), Aug 2001

URL: http://efdeportes.com/efd39/estad.htm

PY: 2001

LE: Intermediate

DE: BASKETBALL-; STATISTICS-; MATCH-ANALYSIS

SH: (546310) BASKETBALL TESTING-AND-EVALUATION; (546045) BASKETBALL COACHING

ITSH: (546310) PALLACANESTRO TEST; (546045) PALLACANESTRO ALLENAMENTO

TI: Basketball statistics: understanding teams' wins and losses through a different game analysis. (Abstract)

AU: Sampaio,-J; Janeira,-M
PB: In Koskolou, M. (ed.), European College of Sport Science, Proceedings of the 7th annual congress of the European College of Sport Science, Athens, Greece, 24-28 July 2002. Volume I, Athens, Pashalidis Medical Publisher, c2002, p.524, Total No. of Pages: 1
CN: European College of Sport Science. Congress (7th: 2002: Athens)
PY: 2002
LE: Advanced
DE: BASKETBALL-; STATISTICS-; WINNING-; LOSING-; MATCH-ANALYSIS; CHAMPIONSHIP-; PROFESSIONAL-; SEASON-; PLAY-OFF; GAME-LOCATION; SCORING-; CLUSTER-ANALYSIS; COMPARATIVE-STUDY
SH: (546177) BASKETBALL STATISTICS-AND-RECORDS
ITSH: (546177) PALLACANESTRO STATISTICA
CL: GV 557.5 #35611 vol.I
SX: This document is available via SIRCExpress Order Number S-866701, https://secure.sportquest.com/su.cfm?articleno=S-866701&title=S-866701

Record 218 of 281 - SPORT Discus

TI: Contributing factors to successive attacks in rugby football games

AU: Sasaki,-K; Murakami,-J; Shimozono,-H; Furukawa,-T; Katuta,-T; Kono,-I
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.167-170, Total No. of Pages: 4
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: RUGBY-UNION; OFFENCE-; STRATEGY-; MATCH-ANALYSIS
SH: (574310) RUGBY-UNION TESTING-AND-EVALUATION; (574189) RUGBY-UNION STRATEGY-OFFENSIVE
ITSH: (574310) RUGBY-UNION TEST; (574189) RUGBY-UNION TATTICA-ATTACCO

Record 219 of 281 - SPORT Discus

TI: Snatch technique of collegiate national level weightlifters

AU: Schilling,-B-K; Stone,-M-H; O'-Bryant,-H-S; Fry,-A-C; Coglianese,-R-H; Pierce,-K-C
SO: Journal-of-strength-and-conditioning-research-(Lawrence,-Kan.) 16(4), Nov 2002, 551-555, Total No. of Pages: 5
PY: 2002
LE: Advanced
DE: WEIGHTLIFTING-; SNATCH-; TECHNIQUE-; UNIVERSITY-; ATHLETE-; STUDENT-; YOUNG-ADULT; FOOT-; BODY-POSITION; BIOMECHANICS-; MAN-; TRAJECTORY-; COMPARATIVE-STUDY
SH: (762027) WEIGHTLIFTING BIOMECHANICS; (762192) WEIGHTLIFTING TECHNIQUES-AND-SKILLS
AB: Bar trajectory during weightlifting movements is related to the position of the body during the lift and the displacement of the feet during the drop-under phase. The purpose of this study was to examine anterior-posterior foot displacement and its relationship with performance in the snatch of collegiate weightlifters. Snatch attempts of men weightlifters from the 1998 U.S.A. Weightlifting Collegiate National Championships were analyzed for horizontal displacement of the feet by video analysis. Lifts were analyzed under 2 conditions: all lifts combined and the heaviest successful attempt for each lifter. Lifts (n = 74) were placed into 4 groups: forward displacement (FD, > 2.5 cm); no displacement (ND, 2.5 cm); rearward displacement (RD, > 2.5 cm); and those that showed asymmetric (AS, > 7 cm difference in right and left foot) displacement of the feet. Chi-square revealed no significant difference in success rate between groups for all attempts. No statistically significant differences were noted between groups in body mass to bar mass ratio or Sinclair formula for heaviest successful attempts. Results indicate that foot displacement did not significantly affect snatch success or lifting ability in collegiate national level lifters.
ITSH: (762027) SOLLEVAMENTO--PESI BIOMECANICA; (762192) SOLLEVAMENTO--PESI TECNICO
CL: GV546 P4 #204
SX: This document is available via SIRCExpress Order Number S-858755, https://secure.sportquest.com/su.cfm?articleno=S-858755&title=S-858755

TI: Zur Lauf- und Sprungbelastung im Basketball
      (Effort de course et de saut en basket-ball.)

TI: About running and jumping actions in basketball

AU: Schmidt,-G-J; von-Benckendorff,-J
SO: Leistungssport-(Muenster) 33(1), Jan 2003, 41-48, Total No. of Pages: 8
PY: 2003
LE: Advanced
DE: EVALUATION-STUDY; MATCH-ANALYSIS; BASKETBALL-; ELITE-ATHLETE; MAN-; SKILL-; RUNNING-; VERTICAL-JUMP; NATIONAL-CHAMPIONSHIP; GERMANY-
SH: (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: Is the modern game of basketball characterized by more running actions and has the game become faster? Using the example of a semifinal of the men's German Championships this question is dealt with. With the aid of an observation instrument, which was validated in the course of the study, the running paths, jumps, passes and throws of all players were recorded and systematically evaluated for all playing positions.
ITSH: (546192) PALLACANESTRO TECNICO
CL: GV701 P4 #420
SX: This document is available via SIRCExpress Order Number S-873339, https://secure.sportquest.com/su.cfm?articleno=S-873339&title=S-873339

TI: Entwicklung der Angriffs-und Verteidigungstaktik im europaeischen Spitzenbasketball
      (En basketball de pointe europeen, evolution des tactiques d' attaque et de defense.)

TI: Development of the offensive and defensive tactics in European top-level basketball

AU: Schmidt,-Gerhard-J; Braun,-Christian
SO: Leistungssport-(Muenster) 34(2), Mar 2004, 30-35;63, Total No. of Pages: 7
PY: 2004
LE: Advanced
DE: BASKETBALL-; EUROPEAN-CHAMPIONSHIP; MAN-; 1999-; 2001-; OFFENCE-; DEFENCE-; FEDERATION-INTERNATIONALE-DE-BASKETBALL-AMATEUR; RULE-; MODIFICATION-; MATCH-ANALYSIS
SH: (546183) BASKETBALL STRATEGY-DEFENSIVE; (546189) BASKETBALL STRATEGY-OFFENSIVE; (546159) BASKETBALL RULES-AND-REGULATIONS
AB: The goal of this study was to conduct a developmental analysis of European top-level basketball on the basis of the Men's European Championships in France in 1999 and in Turkey in 2001 and to point out changes as well as trends. Particularly the rule changes introduced by the FIBA in 2000/01 were examined as to their influence on the structure of the game.
ITSH: (546183) PALLACANESTRO TATTICA-DIFESA; (546189) PALLACANESTRO TATTICA-ATTACCO; (546159) PALLACANESTRO REGOLA
CL: GV701 P4 #420
SX: This document is available via SIRC Document Delivery Service - Article Number S-969898, http://articles.sirc.ca/search.cfm?id=S-969898

TI: Validity and reliability of a voice-recognition game analysis system for field sports

      (Validite et fiabilite d' un systeme d' analyse de jeux par reconnaissance vocale pour le activites de terrain.)
AU: Schokman,-P; Le-Rossignol,-P-F; Sarrow,-W-A
SO: Journal-of-science-and-medicine-in-sport-(Belconnen,-A.C.T.) 5(4), Dec 2002, 362-371, Total No. of Pages: 10
PY: 2002
LE: Advanced
DE: MATCH-ANALYSIS; GAIT-; MEASUREMENT-; METHOD-; EVALUATION-; COMPUTER-PROGRAM

SH: (900970) COACHING-COMPUTER-APPLICATIONS; (911590) INFORMATION-SCIENCE-&-TECHNOLOGY-EQUIPMENT-SOFTWARE

AB: The purpose of this study was to assess the ability of observers to use voice-recognition analysis to accurately classify gait transitions and quantify gait durations typical of team games. Inter-rater and intra-rater reliability was also determined. Four males were filmed performing pre-determined gait protocols, each comprising different sequences of walking, jogging, running and sprinting. Two operators independently classified gait transitions and the time spent in each gait was determined by the voice recognition system. All gait modes as measured by trained observers demonstrated statistically significant correlations ($p<0.01$) to pre-determined measurement criteria. The mean absolute error for all gait transitions was less than half a second (0.32-0.36 s) with the maximum percentage error being approximately 4% for the walk, jog and run gaits and 10% for sprinting. Gait classification error was low at 1.9%. The intra-rater and inter-rater reliability was consistently high ranging from $r=0.87$ to 0.99. In conclusion, observers using voice-recognition software provided valid measures of time spent in each of the four gait categories with 90% or better accuracy achieved.

ITSH: (900970) ALLENAMENTO-APPLICAZIONI-INFORMATICHE; (911590) INFORMATICA/TECNOLOGIA-SOFTWARE

CL: RC1200 #2600

SX: This document is available via SIRCExpress Order Number S-865030, https://secure.sportquest.com/su.cfm?articleno=S-865030&title=S-865030

Record 223 of 281 - SPORT Discus

TI: The use of a movement and skills analysis system to measure player performances in Australian Football - an intervention case study : Final report to the Australian Football League, 12th March 2003

AU: Schokman,-P; Sparrow,-W-A; Le-Rossignol,-P

CA: AFL-Research-Board; Australian-Football-League

PB: [Australia], s.n., 2003, 10 p. : ill.

PY: 2003

LE: Advanced

DE: AUSTRALIAN-FOOTBALL; VIDEOTAPE-; MATCH-ANALYSIS; COMPUTER-PROGRAM; CASE-STUDY; TRAINING-; SKILL-

SH: (542305) AUSTRALIAN-FOOTBALL TECHNOLOGY - COMPUTER-APPLICATIONS; (542045) AUSTRALIAN-FOOTBALL COACHING

AB: Using a computerised game analysis system, this project analysed the effectiveness of a specialized coaching program on five (5) senior players from the Carlton Football Club in season 2002. The aim was to assess whether or not the coaching program affected player fitness (did the players 'work harder' during training and games) and skills performance (did the players handle the ball more in training and games?).

ITSH: (542305) FOOTBALL-AUSTRALIANO TECNOLOGIA - APPLICAZIONI-INFORMATICHE; (542045) FOOTBALL-AUSTRALIANO ALLENAMENTO

Record 224 of 281 - SPORT Discus

TI: High-speed video analysis: when is enough enough. (Abstract)

AU: Schrag,-D; Adermann,-D

PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.471, Total No. of Pages: 1

URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs471a.htm

CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)

PY: 2000

LE: Advanced

DE: BIOMECHANICS-; VIDEOTAPE-; EVALUATION-

SH: (946700) BIOMECHANICS-SKILLS-ANALYSIS

ITSH: (946700) BIOMECCANICA-ANALISI-DELLE-ABILITA

Biomechanical research in sports has greatly benefited from the rapid improvement in technology, particularly during the past decade. Improvement in availability, decrease in cost and better user friendly operation have delivered to the user a high-speed video analysis system which is rapidly gaining widespread acceptance by sports and biomechanical researchers. Researchers and athletes alike have benefited by having more data for analysis and in turn the benefits have flowed to actual sports performance.

From the days of Muybridge and the first "slow motion" the analysis of movement and quantification of human movement has been studied in detail. The data from these studies has been used to better understand biomechanics and to make predictive mathematical models used to enhance the performance of the athletes.

With high-speed video acquisition becoming readily available to all, not just the elite athlete, many factors need to be explored. When is it an advantage to gather large amounts of data? when is it a disadvantage? When collecting high-speed video data what limitations exist? what are the benefits to the researcher? how do I determine the best sampling rates to provide sufficient data? do I use Nyquist or some other method? How many cameras should be utilized? should it be 2-D or 3-D data? These questions will be answered and some general guidelines established as to when, how and if high-speed video analysis is required. Using existing research in the field as an example, a brief sysnopsis of how to analyze this data will also be discussed.

TI: The fallacy of the use of pure statistics in sport. (Abstract)

AU: Serrallach,-G; Martin,-A
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.269, Total No. of Pages: 1
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: MATCH-ANALYSIS; STATISTICS-; PERFORMANCE-PREDICTION; MATHEMATICAL-MODEL
SH: (902565) COACHING-STATISTICS; (540310) TEAM-SPORTS TESTING-AND-EVALUATION
ITSH: (902565) ALLENAMENTO-STATISTICA; (540310) SPORT-DI-SQUADRA TEST

TI: Structure of expert players' activity during competitive interaction in table tennis

AU: Seve,-C; Saury,-J; Ria,-L; Durand,-M
SO: Research-quarterly-for-exercise-and-sport-(Reston,-Va.) 74(1), Mar 2003, 71-83, Total No. of Pages: 13
PY: 2003
LE: Advanced
DE: TABLE-TENNIS; ELITE-ATHLETE; MATCH-ANALYSIS; STRATEGY-; DECISION-MAKING; TIME-FACTOR; PROGRESSION-
SH: (708147) TENNIS PSYCHOLOGY
AB: This study analyzed the activity of expert table tennis players during a match, in reference to course of action theory (Theureau, 1992). Matches were videotaped, and the players' verbalizations as they viewed the tapes were collected a posteriori. The data was analyzed by (a) transcribing the players' actions and verbalizations, (b) decomposing their activity into elementary units of meaning, and (c) grouping the elementary units into larger sets. The results showed that the matches began with an inquiry into the specific features of the opponent's play. This was followed by reproducing the actions identified as effective during the inquiry. The results are discussed in relation to the role of training in expert performance.

ITSH: (708147) TENNIS PSICOLOGIA
CL: GV201 #3561
SX: This document is available via SIRCExpress Order Number S-880029, https://secure.sportquest.com/su.cfm?articleno=S-880029&title=S-880029

TI: Analysis of Cui Wenhua's snatch technique - 200.5 kg, exceeding the world record

AU: Shan,-X-H; Yan,-Z; Zhang,-Y
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 22(4), 1999, 48-51, Total No. of Pages: 4
PY: 1999
LE: Intermediate
DE: WEIGHTLIFTING-; SNATCH-; BIOMECHANICS-; TECHNIQUE-; CUI,-W.; MAN-; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (762027) WEIGHTLIFTING BIOMECHANICS
AB: In the 8th National Game of China, Cui Wenhua snatched 200.5 kg which exceeded the old snatch world record. His technique was video-recorded and analyzed on the Engine Video Analysis Performance Syster. The results showed: 1) His barbell center got up through the trajectory of the body center, keeping close to it with less relative maximum deviation. 2) Cui's barbell center went upward with large vertical velocity. 3) The relative maximum height of the upcast barbell center (the percentage relative to the height of the body) was high. 4) During the jump phase, Cui produced downward acceleration with the absolute value more than that of the acceleration of gravity(9.8m/s2). 5) The slipping technique was adopted giving prominence to the characteristics of low and stable receiving point.
ITSH: (762027) SOLLEVAMENTO--PESI BIOMECANICA
CL: GV201 #5440
SX: This document is available via SIRCExpress Order Number S-655919, https://secure.sportquest.com/su.cfm?articleno=S-655919&title=S-655919

TI: Analysis of loading and effort of wing players in team handball (Primoz Pori, Ph.D.)

(Analiza obremenitev in napora krilnih igralcev v rokometu (dr. Primoz Pori).)
AU: Sibila,-M
SO: Kinesiologia-slovenica-(Ljubljana) 9(2), Dec 2003, 86-88, Total No. of Pages: 3
PY: 2003
LE: Advanced
DE: TEAM-HANDBALL; WING-; ATHLETE-; TRAINING-LOAD; EXERCISE-; LACTATE-; HEART-RATE; MATCH-ANALYSIS; COMPUTER-
SH: (981001) PHYSIOLOGY-EXERCISE; (584127) TEAM-HANDBALL PHYSIOLOGY
AB: This doctoral thesis provides an evaluation of wing player loading and effort levels in a team handball game. Measurement technology and computer video analysis was used to determine the volume and intensity of cyclic movements during matches and training. The subjects and hypotheses of this thesis were based on recent discoveries concerning loading and effort in handball matches. The author focused only on wing player energy mechanisms during handball matches. Differences were established between the selected loading and effort variables of a wing player in the first defence player position in 6:0 zone defence, and those of a defence player in 3:2:1 zone defence. The sample consisted of 12 wing players in the junior-men age category. Data was collected on player loading and effort in six model matches, and in each match, four players were analyzed. Video cameras were used to record the matches, which were then processed using the SAGIT System. The volume and intensity of cyclic movements, acyclic activities, absolute and relative heart rate values and blood lactate levels were also recorded. Descriptive statistics were used to test the hypotheses, and results showed that in both cases, the intensity and volume of cyclic activities was reduced in the match's second part. This was also reflected in the effort variables.
ITSH: (981001) FISIOLOGIA-DELL'ESERCIZIO; (584127) PALLAMANO-DI-SQUADRA FISIOLOGIA
CL: QP302 P4 #240
SX: This document is available via SIRCExpress Order Number S-938854, https://secure.sportquest.com/su.cfm?articleno=S-938854&title=S-938854

TI: Video analysis made easy - using dart trainer software

AU: Skinner,-J; Walker,-J
SO: World-clinic-series-(Fort-Lauderdale,-Fla.) 352003, 98-107, Total No. of Pages: 10
CN: American Swimming Coaches Association. Annual World Clinic (35th : 2003 : San Diego).
PY: 2003
LE: Intermediate
DE: SWIMMING-; COACHING-; VIDEOTAPE-; EVALUATION-; COMPUTER-PROGRAM
SH: (902625) COACHING-TEACHING-AIDS; (902040) COACHING-EQUIPMENT
AB: Jonty Skinner and John Walker talk about the computer technology they use to create videotapes of athlete technique.
ITSH: (902625) ALLENAMENTO-SUSSIDI-DIDATTICI; (902040) ALLENAMENTO-EQUIPAGGIAMENTO
CL: GV836.2 #860
SX: This document is available via SIRCExpress Order Number S-932992, https://secure.sportquest.com/su.cfm?articleno=S-932992&title=S-932992

TI: Performance evaluation of swimmers

(Evaluation de la performance des nageurs: bases scientifiques.)
AU: Smith,-D-J; Norris,-S-R; Hogg,-J-M
SO: Sports-medicine-(Auckland,-N.Z.) 32(9), 2002, 539-554, Total No. of Pages: 16
PY: 2002
LE: Advanced
DE: SWIMMING-; ACHIEVEMENT-; SKILL-; EVALUATION-; PHYSIOLOGY-; PSYCHOLOGY-
SH: (408310) SWIMMING TESTING-AND-EVALUATION; (408147) SWIMMING PSYCHOLOGY; (408127) SWIMMING PHYSIOLOGY
AB: The purpose of this article is to provide a critical commentary of the physiological and psychological tools used in the evaluation of swimmers. The first-level evaluation should be the competitive performance itself, since it is at this juncture that all elements interplay and provide the 'highest form' of assessment. Competition video analysis of major swimming events has progressed to the point where it has become an indispensable tool for coaches, athletes, sport scientists, equipment manufacturers, and even the media. The breakdown of each swimming performance at the individual level to its constituent parts allows for comparison with the predicted or sought after execution, as well as allowing for comparison with identified world competition levels. The use of other 'on-going' monitoring protocols to evaluate training efficacy typically involves criterion 'effort' swims and specific training sets where certain aspects are scrutinised in depth. Physiological parameters that are often examined alongside swimming speed and technical aspects include oxygen uptake, heart rate, blood lactate concentration, blood lactate accumulation and clearance rates. Simple and more complex procedures are available for in-training examination of technical issues. Strength and power may be quantified via several modalities although, typically, tethered swimming and dry-land isokinetic devices are used. The availability of a 'swimming flume' does afford coaches and sport scientists a higher degree of flexibility in the type of monitoring and evaluation that can be undertaken. There is convincing evidence that athletes can be distinguished on the basis of their psychological skills and emotional competencies and that these differences become further accentuated as the athlete improves. No matter what test format is used (physiological, biomechanical or psychological), similar criteria of validity must be ensured so that the test provides useful and associative information concerning current or future performance. The practical worth of any proposed testing or monitoring protocol should be carefully evaluated. In addition, the developmental stage of the athletes) in question should be reflected in the testing/monitoring programme. Finally, increasing technological innovations will bring to the pool deck or dry-land training area simple, fast and advanced diagnostic tools, particularly in the areas of blood-borne markers of training response and neuromuscular excitability.
ITSH: (408310) NUOTO TEST; (408147) NUOTO PSICOLOGIA; (408127) NUOTO FISIOLOGIA
CL: RC1200 #1200
SX: This document is available via SIRCExpress Order Number S-838997, https://secure.sportquest.com/su.cfm?articleno=S-838997&title=S-838997

TI: Penalty shot importance, success and game context in international water polo

AU: Smith,-H-K
SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 7(2), June 2004, 221-225, Total No. of Pages: 5
PY: 2004
LE: Advanced
DE: WATER-POLO; PENALTY-SHOT; ACHIEVEMENT-; STATISTICS-; MATCH-ANALYSIS
SH: (430177) WATER-POLO STATISTICS-AND-RECORDS

AB: To establish the incidence, timing and quantitative importance of penalty shots in water polo and to test whether or not penalty shot success would vary with the context (closeness quarter, criticality) of the game, official records from six major international tournaments (n= 296 games) were analysed. Across all tournaments, penalties (n= 206) were awarded (1-3 per game) in 51% of games with no difference in frequency between game quarters. Penalty goals (n= 165) comprised only 3.7% of all goals scored, whereas the outcome of penalties (goal/no goal) within each game affected the final outcome (win/loss/tie) of 20% of games. The success rate of penalty shots (80.1%) was not significantly different between games classed as either close or non-close, by a mathematical expression of the running average goal difference up until the time of the penalty, and by the absolute difference of the score at the time of the penalty. Nor was this success rate significantly different between game quarters (72.7, 83.0, 81.5, and 81.8%), or between games classified by their criticality to final tournament placing (80.0, 79.5, and 80.6%, from highest to lowest). Thus, during international water polo, penalties contribute only modestly to game outcome, and penalty shot success is not significantly related to the closeness, quarter, or criticality of the game being played.

ITSH: (430177) PALLANUOTO STATISTICA
CL: RC1200 #2600:
SX: This document is available via SIRCExpress Order Number S-954370, https://secure.sportquest.com/su.cfm?articleno=S-954370&title=S-954370

TI: Time-motion analysis of elite field hockey.

AU: Spencer,-M; Lawrence,-S; Rechichi,-C; Dawson,-B; Goodman,-C
CA: Australian-Conference-of-Science-and-Medicine-in-Sport-2002-:-Melbourne,
SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 5(4 Suppl), 2002, 102, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2002/acsms/Papers/Spencer2.asp
PY: 2002
LE: Advanced
DE: BISHOP,-D.; FIELD-HOCKEY; MATCH-ANALYSIS; ELITE-ATHLETE; MAN-; AUSTRALIA-
SH: (554310) FIELD-HOCKEY TESTING-AND-EVALUATION
ITSH: (554310) HOCKEY-SU-PRATO TEST
CL: RC1200 #2600:
SX: This document is available via SIRCExpress Order Number S-968489, https://secure.sportquest.com/su.cfm?articleno=S-968489&title=S-968489

Limited information exists about the movement patterns of field-hockey players during elite competition. Time-motion analysis was used to document the motion activity during an international game. Fourteen field players from the Australian Men's Hockey Team (Mean ± SD mass: 76.7 ± 5.6 kg, V&O2max: 57.9 ± 3.6 ml•kg-1•min-1) were filmed during the game. The majority of the total player game time was spent in the motions of walking and jogging (46.5 ± 8.1 and 40.5 ± 7.0%, respectively). In comparison, the relative contribution of striding and sprinting was minimal (4.1 ± 1.1 and 1.5 ± 0.6%, respectively). On average, a change in motion activity was recorded every 5.5 s. Our criteria for 'repeated-sprint' (defined as a minimum of three sprints, with mean recovery duration between sprints < 21 s) was met on seventeen occasions (team total) during the game, with a mean sprint number of 4 ± 1. In summary, the results suggest that the motion activities of elite field-hockey competition are similar to those of elite soccer, rugby and AFL. In addition, the novel investigation of repeated-sprint activity has provided evidence on the specific nature of this important fitness component during competition.

TI: Time-motion analysis of elite field hockey during several games in succession: a tournament scenario. (Abstract)

AU: Spencer,-M; Rechichi,-C; Lawrence,-S; Bishop,-D; Dawson,-B; Goodman,-C
CA: Australian-Conference-of-Science-and-Medicine-in-Sport-2002-:-Melbourne,
SO: Journal-of-science-and-medicine-in-sport-(Canberra,-Aust.) 5(4 Suppl), 2002, 33, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2002/acsms/Papers/Spencer1.asp
PY: 2002
LE: Advanced
DE: FIELD-HOCKEY; TOURNAMENT-; MATCH-ANALYSIS; MOVEMENT-; PATTERN-; AUSTRALIA-
SH: (554310) FIELD-HOCKEY TESTING-AND-EVALUATION
ITSH: (554310) HOCKEY-SU-PRATO TEST
CL: RC1200 #2600:
SX: This document is available via SIRCExpress Order Number S-968246, https://secure.sportquest.com/su.cfm?articleno=S-968246&title=S-968246

While many studies have investigated the motion activity of team-sport performance, no studies to date have investigated the motion activities of several games in succession (i.e., a tournament scenario). The purpose of this study was to document the motion activity of fourteen players from the Australian Men's Hockey Team (Mean ± SD mass: 76.7 ± 5.6 kg, V&O2 max: 57.9 ± 3.6 ml•kg-1•min-1) during three successive games of an international tournament. The percent of total game time spent standing significantly increased across all games (7.4 ± 1.2, 11.2 ± 2.7 and 15.6 ± 5.6%, respectively, P<0.05), while the percent time spent jogging significantly decreased from game 1 to game 2 and game 1 to game 3 (40.5 ± 7.3, 34.8 ± 7.4 and 29.4 ± 5.7%, respectively, P<0.05). Furthermore, the percent time spent striding significantly increased from game 1 to game 3 and game 2 to game 3 (4.1 ± 1.3, 5.1 ± 0.9 and 5.8 ± 1.4%, respectively, P<0.05). The number of 'repeated-sprint bouts' (defined as a minimum of three sprints, with mean recovery duration between sprints < 21 s) decreased across the three games (17, 11 and 8 bouts, respectively). In summary, a residual fatigue is evident when elite hockey players play several games in succession, as represented by the change in motion activity

TI: Science and football IV

AU: Spinks,-W; Reilly,-T; Murphy,-A
PB: London, Routledge, 2002, 433 p.
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: RUGBY-UNION; RUGBY-LEAGUE; AMERICAN-FOOTBALL; AUSTRALIAN-FOOTBALL; FOOTBALL-; SOCCER-; CONGRESS-; BIOMECHANICS-; PHYSICAL-FITNESS; TESTING-; MATCH-ANALYSIS; SPORTS-MEDICINE; NUTRITION-; PEDIATRICS-; PSYCHOLOGY-; TRAINING-; WOMAN-; ADMINISTRATION-
SH: (560003) FOOTBALL GENERAL WORKS; (566003) GAELIC-FOOTBALL GENERAL WORKS; (576003) SOCCER GENERAL WORKS; (57400)
AB: "The book contains nearly seventy papers, examining aspects ranging from match analysis and medical aspects of football to metabolism and nutrition, psychology and behaviour, and management and organisation in football. Containing a wealth of research data, and a huge range of examples of scientific applications in football, this book represents an invaluable reference for coaches, trainers, managers, medical staff, and all those involved in supporting performers in the many football codes."
ITSH: (560003) FOOTBALL-AMERICANO GENERALITA; (566003) FOOTBALL-GAELICO GENERALITA; (576003) CALCIO GENERALITA; (57400)

TI: Vorkpalli ulesmarkimisprogramm "Mang" ja sellele tehtud taiendused

TI: Original system for recording volleyball games using the computer program

AU: Stamm,-R; Stamm,-M; Loko,-J; Nurmekivi,-A

SO: Kehakultuuriteaduskonna-teadus-ja-oppemetoodiliste-toode-kogumik-(Tartu) 92001, 172-182, Total No. of Pages: 11

PY: 2001

LE: Intermediate

DE: VOLLEYBALL-; MATCH-ANALYSIS; COMPUTER-PROGRAM

SH: (588045) VOLLEYBALL COACHING; (588305) VOLLEYBALL TECHNOLOGY - COMPUTER-APPLICATIONS

AB: In order to improve the quality of volleyball games, assess the level of players, help the coach make appropriate decisions, and analyze the contribution of each player, games should be recorded. In this article, an original Estonian system for recording volleyball games using the computer program, Game, is presented. The program registers nine elements of the game. These nine elements are serve, reception, attack from zone 2, attack from zone 3, attack from zone 4, attack from the back zones, feint, block and dig. The registration of the elements has been made as simple as possible with the aim of achieving great speed and precision at recording them. Each element can be entered by three keystrokes (the first of them determines the element, the second the grade, and the third the player who performed it). The game can be currently analyzed (for example during the intervals). Rapid analysis can be obtained during the game according to the players and elements performed. Proficiency is calculated by the following formula: number of performances x maximum grade - sum of grades over (maximum grade - 1) x number of performances. Technical requirements: at least 386 processor with at least 2 Mb of memory and % Mb of free hard disk space. The program works with MS-DOS 6.0 and higher. The program is compatible with Windows 95. Knowing the players' level of technical elements performance, the coach can plan practices, taking into consideration the individual skills of all the players. Analyzing the data gathered about the team, the coach can modify team tactics. Immediately receiving data on proficiency during the game, the coach can make appropriate changes and attempt to alter the course of the game. Through the application of the recording system, Game, it is possible to follow the players' development in performing technical elements, objectively evaluate the game, and find the most proficient players of the tournament or the season.

ITSH: (588045) PALLAVOLO ALLENAMENTO; (588305) PALLAVOLO TECNOLOGIA - APPLICAZIONI-INFORMATICHE

CL: GV557 #40

SX: This document is available via SIRCExpress Order Number S-811642, https://secure.sportquest.com/su.cfm?articleno=S-811642&title=S-811642

Record 236 of 281 - SPORT Discus

TI: The theory of interactions: general consistent patterns of competitions participants' interactions in martial arts and sports games.

AU: Svischev,-I-D

SO: Teorija-i-praktika-fiziceskoj-kul'-tury-(Moscow) (4), 2001, 39-43, Total No. of Pages: 5

PY: 2001

LE: Intermediate

DE: SOCCER-; EUROPEAN-CUP; JUDO-; SKILL-; MATCH-ANALYSIS; TIME-FACTOR; OFFICIATING-

SH: (669174) JUDO SPORTING-EVENTS; (669117) JUDO OFFICIATING; (576117) SOCCER OFFICIATING; (576174) SOCCER SPORTING-EVENTS

AB: Any theory is created with the purpose of an explanation of the already available facts, their modeling and forecast of development for the future. The theory of interactions of the persons in concrete kinds of sports is also called to explain the structure of the construction of the interactions of the contradictory parties to simulate them in training states and to operate by the course of an antagonism in competitive conditions. Interactions is the category reflecting the processes of influence each on other of the persons, divided in space and time on their power and contents, and their mutual conditionality. The symmetry plays an appreciable role in the daily life. The symmetry is a constancy of the principles of the biomechanics concerning any changes of the form in the trajectory of movement.

ITSH: (669174) JUDO COMPETIZIONE-SPORTIVA; (669117) JUDO ARBITRAGGIO; (576117) CALCIO ARBITRAGGIO; (576174) CALCIO COMPETIZIONE-SPORTIVA

CL: GV201 #4060

SX: This document is available via SIRCExpress Order Number S-778108, https://secure.sportquest.com/su.cfm?articleno=S-778108&title=S-778108

TI: Evaluation of muscle damage after a rugby match with special reference to tackle plays

AU: Takarada,-Y
SO: British-journal-of-sports-medicine-(London) 37(5), Oct 2003, 416-419, Total No. of Pages: 4
PY: 2003
LE: Advanced
DE: RUGBY-; TACKLING-; COMPETITION-; MUSCLE-; INJURY-; AMATEUR-; ATHLETE-; YOUNG-ADULT; PLASMA-; CREATINE-KINASE; MYOGLOBIN-; LACTATE-; POTASSIUM-; SODIUM-; MATCH-ANALYSIS
SH: (574093) RUGBY-UNION INJURIES-AND-ACCIDENTS; (959900) INJURIES-AND-ACCIDENTS-MUSCLE-INJURIES
AB: Objective: to investigate blood indices of muscle damage after a competitive rugby match. Methods: fifteen elite amateur rugby players volunteered to participate (mean (SE) age 26.6 (0.7) years, height 179.8 (1.0) cm, weight 87.4 (2.2) kg, and VO2MAX 58.5 (1.2) ml/kg/min). The study was conducted after two competitive matches during the 1999-2000 season. Plasma concentrations of lactate, potassium (K), sodium (Na), and myoglobin, and the activity of creatine kinase were measured before and after the matches. In addition, the number of tackles by and on each subject and the average duration of the work and rest periods were analysed using video recordings of the matches. Results: myoglobin concentration and creatine kinase activity showed appreciable transient increases after the match. Peak values for myoglobin concentration (980 (166) mug/l) and creatine kinase activity (1081 (159) U/I) were observed 45 minutes and 24 hours after the match respectively. Positive and significant correlations were observed between the number of tackles and both peak myoglobin concentration ($r = 0.85$, $p < 0.01$; $n = 14$) and peak creatine kinase activity ($r = 0.92$, $p < 0.01$; $n = 14$). Plasma lactate and K concentrations also showed appreciable increases after the match, whereas plasma Na concentration showed a gradual decrease. The mean duration of the work and rest periods were 21.5 (2.2) and 24.3 (3.1) seconds respectively. Conclusions: the rugby matches resulted in serious structural damage to the muscles, the extent of which was highly dependent on the number of tackles.
ITSH: (574093) RUGBY-UNION INFORTUNI-E-INCIDENTI; (959900) INFORTUNI-E-INCIDENTI-INFORTUNI-MUSCOLARI
CL: RC1200 #300
SX: This document is available via SIRCExpress Order Number S-921311, https://secure.sportquest.com/su.cfm?articleno=S-921311&title=S-921311

TI: The offensive process in basketball - a study in high performance junior teams

AU: Tavares,-F; Gomes,-N
SO: International-journal-of-performance-analysis-in-sport-(Cardiff) 3(1), Apr 2003, 34-39, Total No. of Pages: 6
PY: 2003
LE: Advanced
DE: BASKETBALL-; OFFENCE-; ACHIEVEMENT-; SKILL-; SUCCESS-; ELITE-ATHLETE; MAN-; JUNIOR-CHAMPIONSHIP; WORLD-CHAMPIONSHIP; TECHNIQUE-; STRATEGY-; MATCH-ANALYSIS; SET-SHOT; FAST-BREAK; COMPARATIVE-STUDY
SH: (546189) BASKETBALL STRATEGY-OFFENSIVE; (546310) BASKETBALL TESTING-AND-EVALUATION; (546192) BASKETBALL TECHNIQUES-AND-SKILLS
AB: This study was conducted to examine a suitable notational analysis system (video analysis combined with hand notation) designed to help field hockey coaches and players improve their performance during penalty corners. Two hundred and fifty penalty corners were analysed using video analysis and a hand notation system. Results indicated that straight shots that shots that were either flicked or undercut were the most successful in scoring goals.
ITSH: (546189) PALLACANESTRO TATTICA-ATTACCO; (546310) PALLACANESTRO TEST; (546192) PALLACANESTRO TECNICO

AU: Tavares,-F; Mendes,-L; Pinto,-D
PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.463, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs463a.htm
CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)
PY: 2000
LE: Advanced
DE: BASKETBALL-; DEFENCE-; EVALUATION-; MATCH-ANALYSIS
SH: (546183) BASKETBALL STRATEGY-DEFENSIVE
ITSH: (546183) PALLACANESTRO TATTICA-DIFESA

The aim of this study was to know the defensive dimension in young basketball players in three analysis domains: (1) cinematic pattern analysis of the defensive stance and the defensive sliding, (2) theoretical game knowledge evaluation on defense, and (3) defensive actions analysis accomplished in game situation.

The sample was comprised by 21 players with an average of 13.8 years old, which were divided in two groups of different experience of practice: G1 (1 to 3 years) and G2 (4 or more years of practice).

The "Peak5 of the Peak Performance Technologies Inc. – Video Analog Motion Measurement Systems" was used to describe the cinematic pattern of the defensive sliding. For the evaluation of the theoretical game knowledge on defense, a written test with defensive contents was applied. The evaluation of the defensive actions in game situation was observed and registered for the several categories in analysis.

Statistic descriptive measures, t-test and tests of independent proportions were used as data analysis techniques.

The cinematic pattern of the defensive stance presents differences between the two groups, in which the players with more years of practice have a more appropriate defensive position to the demands of the accomplishment of the respective defensive tasks. Differences were observed in theoretical game knowledge of the defensive fundamentals on the rules questions. Concerning the appropriate accomplishment of defensive actions in the game, players with more years of practice accomplish better those actions, and the differences were in the following sub-categories: (i) player with the ball defence, (ii) deny defence, (iii) help-side defence, (iv) pass and go defence and (v) box out.

Record 240 of 281 - SPORT Discus

AU: Tenga,-A-P-C
SO: Moving-bodies-=-menneske-i-bevegelse-(Oslo) 1(2), 2003, 49-60, Total No. of Pages: 12
PY: 2003
LE: Advanced
DE: SOCCER-; MATCH-ANALYSIS; MOVEMENT-
SH: (576310) SOCCER TESTING-AND-EVALUATION
ITSH: (576310) CALCIO TEST
CL: GV942 #1020

Record 241 of 281 - SPORT Discus

TI: Jumping and landing techniques in elite women's volleyball

AU: Tillman,-M-D; Hass,-C-J; Brunt,-D; Bennett,-G-R
SO: Journal-of-sports-science-and-medicine-(Bursa) 3(1), Mar 2004, 30-36, Total No. of Pages: 7
URL: http://www20.uludag.edu.tr/%7Ehakan/sbtd/vol3/n1/5/v3n1-5pdf.pdf
PY: 2004
LE: Advanced
DE: VOLLEYBALL-; INJURY-; JUMPING-; LANDING-; TECHNIQUE-; OCCURRENCE-; PATTERN-; WOMAN-; COMPETITION-; DIVISION-I; VIDEOTAPE-; BLOCK-; SPIKE-; MATCH-ANALYSIS
SH: (588093) VOLLEYBALL INJURIES-AND-ACCIDENTS; (588027) VOLLEYBALL BIOMECHANICS; (588192) VOLLEYBALL TECHNIQUES-AND-SKILLS
AB: Volleyball has become one of the most widely played participant sports in the world. Participation requires expertise in many physical skills and performance is often dependent on an individual's ability to jump and land. The incidence of injury in volleyball is similar to the rates reported for sports that are considered more physical contact sports. Though the most common source of injury in volleyball is the jump landing sequence, little research exists regarding the prevalence of jumping and landing techniques. The purpose of this study was to quantify the number of jumps performed by female volleyball players in competitive matches and to determine the relative frequency of different jump-landing techniques. Videotape recordings of two matches among four volleyball teams were analyzed for this study. Each activity was categorized by jump type (offensive spike or defensive block) and phase (jump or landing). Phase was subcategorized by foot use patterns (right, left, or both). Each of the players averaged nearly 22 jump-landings per game. Foot use patterns occurred in unequal amounts (p < 0.001) with over 50 % of defensive landings occurring on one foot. Coaches, physical educators, and recreation providers may utilize the findings of this inquiry to help prevent injuries in volleyball.
ITSH: (588093) PALLAVOLO INFORTUNI-E-INCIDENTI; (588027) PALLAVOLO BIOMECANICA; (588192) PALLAVOLO TECNICO

Record 242 of 281 - SPORT Discus

TI: The playing pattern of world's top single badminton players

AU: Tong,-Y-M; Hong,-Y
PB: In Hong, Y. (ed.), Proceedings of XVIII International symposium on biomechanics in sports, Hong Kong, Department of Sports Science and Physical Education. The Chinese University of Hong Kong, c2000, p.825-830, Total No. of Pages: 6
CN: International Symposium on Biomechanics in Sport (18th : 2000 : Hong Kong).
PY: 2000
LE: Advanced
DE: BADMINTON-; ELITE-ATHLETE; MAN-; VIDEOTAPING-; STROKE-; TECHNIQUE-; STRATEGY-; MATCH-ANALYSIS
SH: (690310) BADMINTON TESTING-AND-EVALUATION; (690180) BADMINTON STRATEGY
ITSH: (690310) BADMINTON TEST; (690180) BADMINTON TATTICA
CL: QP 303 #35459

Record 243 of 281 - SPORT Discus

TI: Dov'e la differenza tra le squadre vincenti e quelle perdenti nella pallacanestro?

(Where is the difference between winning and losing teams in basketball?)

AU: Trninc,-S; Milanovic,-D; Dizdar,-D
SO: SDS,-Rivista-di-cultura-sportiva-(Roma) 16(38), Apr/June 1997, 49-56
PY: 1997
LE: Advanced
DE: BASKETBALL-; STATISTICS-; MATCH-ANALYSIS; MULTIVARIATE-ANALYSIS
SH: (546310) BASKETBALL TESTING-AND-EVALUATION
AB: The goal of the study is to establish the predictive value of 13 indicators of game effectiveness in order to discriminate between winning and losing teams. An attempt also was made in order to rank these indicators in order of importance for the final result of the match, i.e. victory or defeat. To this purpose, an investigation was carried out during the 1994 World Basketball Championships, on 16 teams. The canonical analysis allowed to detect the differences between the winning and losign teams through the selected indicators. The discriminating function allowed to distinguish between winning and losing teams with a high level of statistical significance, with a relatively high value of canonical correlation (0.76), thus confirming the substantive and predictive value of the 13 indicators of playing effectiveness selected.
ITDE: pallacanestro-; statistica-; analisi-del-gioco; analisi-multivariata
ITAB: La ricerca aveva l' obiettivo di stabilire se, nella pallacanestro, tredici indicatori standardizzati dell'efficacia del gioco siano in grado di differenziare le squadre vincenti da quelle perdenti. Inoltre si e cercato di determinare quale sia l' ordine di importanza di questi indicatori per il risultato finale della partita, definito come vittoria o sconfitta. A questo scopo e stato realizzato uno studio che riguardava le partite disputate durante i campionati mondiali di pallacanestro, svoltisi nel 1994, ai quali hanno preso parte sedici squadre. Per mezzo dell'analisi canonica sono state rilevate le differenze tra squadre vincenti e perdenti sui tredici indicatori. La funzione canonica discriminante permette di distinguere essenzialmente le squadre vincenti da quelle perdenti con una correlazione canonica particolarmente elevata (0,76), confermando il valore predittivo degli indicatori utilizzati.
ITSH: (546310) PALLACANESTRO TEST

Record 244 of 281 - SPORT Discus

TI: The role that the time of the offensive duration playes ot the efficacy of a basketball team

AU: Tsamourtzis,-E; Fylaktakidou,-A; Taxildaris,-K
SO: Exercise-and-society-journal-of-sport-science-(Komotini) (27), 2001, 32-43, Total No. of Pages: 12
PY: 2001
LE: Advanced
DE: BASKETBALL-; TIME-FACTOR; OFFENCE-; BLOCKING-; SHOOTING-; SCORING-; MATCH-ANALYSIS; VIDEOTAPING-; ELITE-ATHLETE; GREECE-
SH: (546189) BASKETBALL STRATEGY-OFFENSIVE
AB: The purpose of this study was to register the time that an offence lasts so as to find out the chronicle period during the 30 sec that the offence shows its greatest activity and efficacy. For the purpose of this study there have been used eighty-eight (88) Basketball videotaped games. More specifically thirty-four (34) of them was about the Greek National Men's Team (World Championship 1994, Europe Championship 1995, Olympic Games 1996, Europe Championship 1997) and fifty-four (54) about the Greek Sport Clubs to the Europe Championships of FIBA 1994-1997. All videotapes were videoanalysed and was used the program for computer VICAS (video computer analyse-system). The comparisons that have been done, was between Greek and Foreign Teams to their wins and their defeats. The time of the 30 sec that an offence can last was divided into six periods (0-5, 5-10, 10-15, 15-20, 20-25 and 25-30 sec). The analyses that we did was a) the way that the offence started (defensive and offensive rebound, steal, basket, out of bounds), b) the way that the offence was completed (two and three point shots, fouls, turnovers), c) assist and d) block. The results of this study showed that the greatest offensive activities was appeared during the first (0-5 sec), second (5-10 sec) and last (25-30 sec) chronicale periods.
ITSH: (546189) PALLACANESTRO TATTICA-ATTACCO
CL: GV701.P4 #1800
SX: This document is available via SIRCExpress Order Number S-794074, https://secure.sportquest.com/su.cfm?articleno=S-794074&title=S-794074

Record 245 of 281 - SPORT Discus

TI: Effektivitaet unterschiedlicher Korbwurfarten im Basketball in Bezug auf die Ausfuehrungsposition
   (Efficacite de divers tirs de panier en basket-ball en fonction de la position d' execution.)

117

TI: The effectiveness of different types of basket shots in basketball as related to the position of their execution

AU: Tsamourtzis,-E; Salonikidis,-K; Siskos,-A; Athanailidis,-I
SO: Leistungssport-(Muenster) 33(2), Mar 2003, 39-44, Total No. of Pages: 6
PY: 2003
LE: Advanced
DE: EVALUATION-STUDY; MATCH-ANALYSIS; BASKETBALL-; WORLD-CHAMPIONSHIP; ELITE-ATHLETE; SHOOTING-; SKILL-
SH: (546288) BASKETBALL TECHNIQUES-AND-SKILLS-SHOOTING
AB: The aim of this article is to determine the effectiveness of basket shots using the recording and analysis of the different types of throws as related to the position of their execution. To this end one hundred games of Greek men's basketball teams were evaluated by means of PC and video. The games were carried out under the auspices of the FIBA at different championships during the competition periods of the years 1994 to 2000.
ITSH: (546288) PALLACANESTRO TECNICO-TIRO
CL: GV701 P4 #420
SX: This document is available via SIRCExpress Order Number S-884320, https://secure.sportquest.com/su.cfm?articleno=S-884320&title=S-884320

Record 246 of 281 - SPORT Discus

TI: Technisch-taktische Merkmale von Siegern und Verlierern bei Herrenbasketballmannschaften
       (Caracteristiques technico-tactiques de vainqueurs et perdants en basket-ball.)

TI: Technical and tactical characteristics of winners and losers in basketball

AU: Tsamourtzis,-E; Salonikidis,-K; Taxildaris,-K; Mawromatis,-G
SO: Leistungssport-(Muenster) 32(1), Jan 2002, 54-58, Total No. of Pages: 5
PY: 2002
LE: Advanced
DE: BASKETBALL-; ELITE-ATHLETE; MAN-; GREECE-; MATCH-ANALYSIS; STRATEGY-
SH: (546180) BASKETBALL STRATEGY; (546310) BASKETBALL TESTING-AND-EVALUATION
AB: The focus of this article is on the documentation and analysis of the frequency of offensive and defensive behavior characteristics of basketball teams, so that coaches and players can get an idea which technical and tactical elements are particularly promising and which are not. To this end 90 basketball matches of Greek men's teams, which were played under the care of the FIBA, were systematically evaluated.
ITSH: (546180) PALLACANESTRO TATTICA; (546310) PALLACANESTRO TEST
CL: GV701 P4 #420
SX: This document is available via SIRCExpress Order Number S-804738, https://secure.sportquest.com/su.cfm?articleno=S-804738&title=S-804738

Record 247 of 281 - SPORT Discus

TI: Relation between social cohesion and team performance in soccer teams

       (Relation entre la cohesion sociale et la performance collective d' equipes de football.)
AU: Tziner,-A; Nicola,-N; Rizac,-A
SO: Perceptual-and-motor-skills-(Missoula,-Mont.) 96(1), Feb 2003, 145-148, Total No. of Pages: 4
PY: 2003
LE: Advanced
DE: SOCCER-; TEAM-; GROUP-COHESION; ACHIEVEMENT-; COMPETITIVE-BEHAVIOUR; INTERPERSONAL-RELATION; SOCIAL-PERCEPTION; ELITE-ATHLETE; QUESTIONNAIRE-; MATCH-ANALYSIS; CORRELATION-
SH: (576168) SOCCER SOCIAL-PSYCHOLOGY; (576042) SOCCER CLUBS-AND-TEAMS; (919250) SOCIAL-PSYCHOLOGY-GROUP-DYNAMICS
AB: Investigations of the influence on team performance of team composition, in terms of task-related attributes, e.g., personality traits, cognitive abilities, often assumes this relation to be mediated by the strength (intensity) of the interpersonal relations (social cohesion) among team members. However, there has been little empirical examination of

118

how much social cohesion actually affects team outcomes. This preliminary study sought to examine this issue using soccer teams, which have been held to resemble workplace teams. Perceptions of team cohesion were collected from 198 Israeli soccer players (comprising 36 national league teams) during the week preceding their weekly games. A significant correlation was found between the perceptions of social cohesion and the results of the soccer matches, indicating a link between team social cohesion and team performance. Implications of the results, as well as the study's limitations, are discussed, and avenues for research are suggested.
ITSH: (576168) CALCIO PSICOLOGIA -SOCIALE; (576042) CALCIO CLAVE-E-SQUADRA; (919250) PSICOLOGIA-SOCIALE-DINAMICA-DI-GRUPPO
CL: BF1 P4 #100
SX: This document is available via SIRC Document Delivery Service - Article Number S-889820, http://articles.sirc.ca/search.cfm?id=S-889820

Record 248 of 281 - SPORT Discus

TI: A case study on "transition" as collective tactics in basketball - based on game analysis of the 18th Asian Basketball Championship for Women

(Etude de cas sur la structure de la phase de transition en tant que tactique collective en basket-ball, basee sur l' analyse du jeu lors des 18e championnats d' Asie de basket-ball feminin.)
AU: Uchiyama,-H; Takei,-M; Oga,-K; Otaka,-T; Sasaki,-K
SO: Bulletin-of-Institute-of-Health-and-Sport-Sciences,-University-of-Tsukuba-(Ibaraki-ken) 242001, 107-120, Total No. of Pages: 14
PY: 2001
LE: Advanced
DE: BASKETBALL-; WOMAN-; ELITE-ATHLETE; TRANSITION-; STRATEGY-; MATCH-ANALYSIS; CASE-STUDY; CHAMPIONSHIP-
SH: (546398) BASKETBALL WOMEN; (546180) BASKETBALL STRATEGY
AB: It is considered that all arguments of basketball studies presuppose the two phases: offense and defense. However, there is a third phase we neglect, which is more important. It's "transition" from offense to defense and defense to offense. The purpose of this study was to provide effective knowledge on coaching and teaching of the tactical training by clarifying the structure of "transition" as collective tactics in basketball game, especially team tactics, which seemed to hold a world class. Subjects were 10 games of four national teams (Korea, Japan, Chinese Taipei and China) in the 18th Asian basketball championship for women. In order to analyze the above, "the analysis of impression (Eindrucksanalyse)" which has been used in research horizon of sportmorphology was adapted as a method, since it has a definite effectiveness for analyzing as "the whole grasp of movement form (ganzheitliches Erfassen)". The main results may be summarized as follows 1. In transferring from defense to offense, there are five things we can do: (1) transfer to midcourt, (2) transfer to fast break, (3) transfer to early offense, (4) transfer to offense, and (5) press if basket has been made. 2. When transferring from offense to defense, there are eight things we must do: (1) triangle on offensive backboard, (2) pressure point of rebounder, (3) off-men in triangle retreat quickly in straight lines, (4) checking strong side lead, (5) checking weak side front line man, (6) pressure on the ball at all times, (7) quick retreat by all men to at least the line of the ball, and (8) tandem defense against a fast break.
ITSH: (546398) PALLACANESTRO DONNE; (546180) PALLACANESTRO TATTICA
CL: RC1200 #340
SX: This document is available via SIRCExpress Order Number S-765317, https://secure.sportquest.com/su.cfm?articleno=S-765317&title=S-765317

Record 249 of 281 - SPORT Discus

TI: Effect of the new scoring system on male volleyball

AU: Urena,-A
SO: The-Coach-(Lausanne) (4), Dec 2000, 12-18, Total No. of Pages: 7
PY: 2000

LE: Intermediate
DE: TREND-ANALYSIS; VOLLEYBALL-; SCORING-; RULE-; TIME-FACTOR; MATCH-ANALYSIS; MEDIA-COVERAGE
SH: (588159) VOLLEYBALL RULES-AND-REGULATIONS
ITSH: (588159) PALLAVOLO REGOLA
CL: GV1015 #581
SX: This document is available via SIRCExpress Order Number S-668629, https://secure.sportquest.com/su.cfm?articleno=S-668629&title=S-668629

TI: Kolmen eritasoisen ryhman pelianalyysi kahdessa jalkapallon pienpelissa

TI: Game analysis of three different groups in two modified game of soccer

AU: Vanttinen,-T; Blomqvist,-M
SO: Liikunta-and-tiede-(Helsinki) 40(5-6 Special suppl.), 2003, 60-65, Total No. of Pages: 6
URL: http://www.datauniversum.fi/a/lts/filearc/136_art9.pdf
PY: 2003
LE: Advanced
DE: BALL-GAME; SOCCER-; MATCH-ANALYSIS; STRATEGY-; TEACHING-; ADOLESCENT-
SH: (576180) SOCCER STRATEGY; (914620) PHYSICAL-EDUCATION-TEACHING
ITSH: (576180) CALCIO TATTICA; (914620) EDUCAZIONE-FISICA-INSEGNAMENTO
CL: GV201 #5480
SX: This document is available via SIRCExpress Order Number S-956345, https://secure.sportquest.com/su.cfm?articleno=S-956345&title=S-956345

The aim of this study was to compare technical and tactical
abilities of soccer players in three different groups (novice-intermediate-
expert). The participants were 14–15 year old males.
Two groups were recruited from a regular school class and one
from a club team playing on the highest national level. All participants
played two different types of modified soccer (3 vs. 3) on
a 32 m x 20 m area for 2 x 5 minutes. The effective playing time
in the passing-game was 75 % and in the goal-game 54 %. The
games were analyzed from the video by using a specific coding
instrument in order to compare technical and tactical abilities of
the players in different games and groups. The results indicated
that in the modified soccer, the players performed on an average
of 48.2 technical actions and 189.1 tactical decisions. The experts
had longer effective playing time, higher amount of actions and
tactical decisions and they were more successful in offensive actions
when compared to their counterparts in the other two
groups. Experts also made more successful decisions in both offensive
and defensive game situations. Based on the present findings,
it is recommended that the role of tactical decision-making
should be emphasized in teaching ball games.

TI: The soccer scout: a statistics analysis. (Abstract)

AU: Vendite,-L; Colucio,-C; Colucio,-S; Moraes,-A
PB: In Sports Medicine Australia, Book of abstracts: 2000 Pre-Olympic Congress: International Congress on Sport Science, Sports Medicine and Physical Education, Brisbane Australia 7-12 September 2000, Australia, The Congress, 2000, p.496, Total No. of Pages: 1
URL: http://www.ausport.gov.au/fulltext/2000/preoly/abs496.htm
CN: International Congress on Sport Science Sports Medicine and Physical Education (2000 : Brisbane, Australia)
PY: 2000
LE: Advanced

DE: SOCCER-; STATISTICS-; EVALUATION-; MATCH-ANALYSIS
SH: (576177) SOCCER STATISTICS-AND-RECORDS
ITSH: (576177) CALCIO STATISTICA

Soccer is a game where during the year many matches are played, and some teams play approximately 80 games. The experience and the results of scientific researches shows that if the coaches use specifics exercises, many skills of the soccer players can be improved. In this study we tried to supply coaches information about the skills, and in this way contribute to technique improvement of the soccer players. In this study, the players are evaluated in the number and percentage of successful actions in different specific skills, like passing, goal kicking, crossing passes, goalkeeping, disarming and intercepting balls. The data was collected during the Brazilian Championship. The Associação Atlética Ponte Preta (Campinas -S.P-Brazil) played 24 matches. Specific software was designed to evaluated the data. The data shows that in the beginning of the championship the average number of completed passes were 48%, goals kicking 31% and crossing passes 27%. After discussion of the data with the coach, the average number of completed passes grew to 69% ($p<0.05$), goals kicking 38% ($p<0.05$) and crossing passes 39% ($p<0.05$) in the finals of the championship. All of the others skills also showed some improvement. Results also verified that when the percentage of disarming moves is small, the number of faults is big, and vice versa. In conclusion, the use of a scout to asssist the technical aspects of the game, could aid the coach to improve the overall performance of the team.

Record 252 of 281 - SPORT Discus

TI: Results of tracking a referee's movements during a basketball match with computer sight

AU: Vuckovic,-G; Dezman,-B
SO: Acta-Kinesiologiae-Universitatis-Tartuensis-(Tartu) 6(Suppl), 2001, 274-277, Total No. of Pages: 4
CN: Sport Kinetics 2001. Conference (2001 : Tartu, Estonia).
PY: 2001
LE: Advanced
DE: BASKETBALL-; OFFICIATING-; EXERCISE-; PHYSICAL-FITNESS; MATCH-ANALYSIS
SH: (546117) BASKETBALL OFFICIATING; (903255) OFFICIATING-PHYSIOLOGY
AB: Altered basketball rules in the year 2000 caused the game to become faster, we therefore presume that the referees' total covered distance at a game and the distances in four velocity classes (walking, slow-run, fast-run, sprint) consequently also increased. We monitored a single referee's movements in one halftime at an official match of the Slovene 1st Division with the help of a computerised system for monitoring movement of players or referees on the court. The match was recorded with two SVHS video cameras attached above the court, each covering half the court, on two synchronised SVHS recorders. Both recordings were then transferred into a computer, digitised, pasted into a unified digital recording. This was analysed with the SAGIT software, developed at the Faculty of Electrical Engineering in Ljubljana in co-operation with experts at the Faculty of Sport. The obtained data was analysed with the Excel programme for Windows 98. We have found that the chosen referee walked 1932 m, ran slowly 855 m, ran quickly 367 m and sprinted 72 m in the monitored halftime. The total covered distance was 3226 m. In the active phases of the game he mostly ran, in the passive phases he mostly walked.
ITSH: (546117) PALLACANESTRO ARBITRAGGIO; (903255) ARBITRAGGIO-FISIOLOGIA
CL: QP302 P4 #260
SX: This document is available via SIRCExpress Order Number S-793034, https://secure.sportquest.com/su.cfm?articleno=S-793034&title=S-793034

Record 253 of 281 - SPORT Discus

TI: Computer tracking of players at squash matches

AU: Vuckovic,-G; Dezman,-B; Erculj,-F; Kovacic,-S; Pers,-J
SO: Acta-Kinesiologiae-Universitatis-Tartuensis-(Tartu) 7(Suppl), 2002, 216-220, Total No. of Pages: 5

CN: International Council of Physical Activity and Fitness Research. Symposium (23rd: 2002: Tartu, Estonia).
PY: 2002
LE: Advanced
DE: SQUASH-RACQUETS; COACHING-; COMPUTER-PROGRAM; BIOMECHANICS-; MATCH-ANALYSIS
SH: (704305) SQUASH-RACQUETS TECHNOLOGY - COMPUTER-APPLICATIONS; (704045) SQUASH-RACQUETS COACHING
AB: Presents Sagit/Squash, a computerized system for tracking squash players during a match and in training, based on technology developed at the Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia.
ITSH: (704305) SQUASH TECNOLOGIA - APPLICAZIONI-INFORMATICHE; (704045) SQUASH ALLENAMENTO
CL: QP302 P4 #260
SX: This document is available via SIRCExpress Order Number S-849937, https://secure.sportquest.com/su.cfm?articleno=S-849937&title=S-849937

Record 254 of 281 - SPORT Discus

TI: Charakterystyka strukturalna i segmentacja ilosciowa gry lidera koszykarskiego

TI: Structural characterization and quantitative segmentation of game for the basketball leader

AU: Wagner,-W; Pluta,-B
SO: Czlowiek-i-ruch-(Wroclaw,-Poland) 3(1), 2001, 106-114, Total No. of Pages: 9
PY: 2001
LE: Advanced
DE: BASKETBALL-; MATCH-ANALYSIS; LEADERSHIP-; MATHEMATICAL-MODEL; MULTIVARIATE-ANALYSIS; STRATEGY-; TECHNIQUE-
SH: (546192) BASKETBALL TECHNIQUES-AND-SKILLS; (546180) BASKETBALL STRATEGY; (902535) COACHING-SOCIAL-PSYCHOLOGY-LEADERSHIP
AB: During a basketball game, players of each team realize the specified technical and tactical activities. In that case, there is of great weight of basketball leader. He is an author of many basketball matches' actions (BMA), which generally include: shooting (S), game constructing (C) and rebounding (R). So, the type of basketball leader depends on the order of the mentioned attributes and their intensity. If only one of attributes is preferred - there are 3 main types of basketball leaders: constructor (C), shooter (S) and rebounder (R). In the multivariate statistical research carried out in the field of basketball, very often-met problem is the huge collection of variables (BMA) done by leader. The contemporary observation of all of these variables is very difficult. The monitoring of them can be simplified by the segmentation of the variables considering definite criterions. If the monitoring of a multivariate observation is carried out by using of the special techniques, giving possibilities for their chronological reconstruction, it is possible to obtain the complete collection of the mentioned variables. Apart from leader's activities refer to the BMA, the positions on basketball court during the game are distinguished, such as: 1 - defensive guard, 2 - shooting guard, 3 - center, 4 - weak forward, 5 - power forward. There are 15 possible types of basketball leaders in the examined case, regarding to the mentioned attributes and positions on court. Such a big number of types causes that the process of analysis concerns only some chosen, particularly consistent with the basketball rules of game. The paper presents the conception of the appointment of the typological pattern of the basketball leader using the dynamic monitoring of game. This method is illustrated with the empirical data concerning the leader of Polish national basketball team.
ITSH: (546192) PALLACANESTRO TECNICO; (546180) PALLACANESTRO TATTICA; (902535) ALLENAMENTO-LEADERSHIP
CL: QP302 P4 #320
SX: This document is available via SIRCExpress Order Number S-923023, https://secure.sportquest.com/su.cfm?articleno=S-923023&title=S-923023

Record 255 of 281 - SPORT Discus

TI: Analysis of the techniques of Chinese and Cuban women volleyball team at 13th volleyball world championships

AU: Wang,-T
SO: Journal-of-Wuhan-Institute-of-Physical-Education-(Wuhan) 34(3), 2000, 71-73, Total No. of Pages: 3
PY: 2000
LE: Advanced

DE: VOLLEYBALL-; TECHNIQUE-; STRATEGY-; MATCH-ANALYSIS; WORLD-CHAMPIONSHIPS; CUBA-; PEOPLE'-S-REPUBLIC-OF-CHINA; WOMAN-; ELITE-ATHLETE; COMPARATIVE-STUDY
SH: (588180) VOLLEYBALL STRATEGY; (588192) VOLLEYBALL TECHNIQUES-AND-SKILLS; (588398) VOLLEYBALL WOMEN

AB: Study showed that Chinese women volleyball team is weaker in offence and blocking, compared with Cuba. Mental state is not stable when serving. China should persist in their traditional play which is characteristic of quickness and improve their blocking ability and serving technique.
ITSH: (588180) PALLAVOLO TATTICA; (588192) PALLAVOLO TECNICO; (588398) PALLAVOLO DONNE

Record 256 of 281 - SPORT Discus

TI: Analysis on sports acrobatic tournaments in 6th world game

AU: Wang,-W-S; Liang,-J-X
SO: Journal-of-capital-college-of-physical-education-(Beijing,-P.R.China) 13(4), 2001, 76-79, Total No. of Pages: 4
PY: 2001
LE: Intermediate
DE: ACROBATICS-; WORLD-CHAMPIONSHIP; COMPETITION-; EVALUATION-; MATCH-ANALYSIS
SH: (608174) ACROBATICS SPORTING-EVENTS

AB: The acrobatic tournament of 6th world game is first time game in new century. It is also first time that applied 2001-2004 international code of points sports acrobatic and tables of difficulty published by international gymnastics association. Based on analysis of first-hand datum from the tournaments, the developing trend of sports acrobatic in new century and the counter-measures for our country were discoursed.
ITSH: (608174) ACROBATICA COMPETIZIONE-SPORTIVA

Record 257 of 281 - SPORT Discus

TI: Commented on 99' national championship of trampoline and acrobatics gymnastics

AU: Wang,-W-S; Liang,-J-X
SO: Journal-of-Beijing-teachers-college-of-physical-education 11(4), 1999, 82-84, Total No. of Pages: 3
PY: 1999
LE: Intermediate
DE: TRAMPOLINING-; ACROBATICS-; TECHNIQUE-; ATHLETE-; SKILL-; MATCH-ANALYSIS; 1999-; PEOPLE'-S-REPUBLIC-OF-CHINA
SH: (608192) ACROBATICS TECHNIQUES-AND-SKILLS; (608310) ACROBATICS TESTING-AND-EVALUATION

AB: This championship not only first merged two events Trampoline and acrobatics gymnastics together to compete but also added collective event of acrobatics gymnastics. It established specially evaluation of the best joining commendation. And to added point for dress during competition of its. Its main measure of reform and strength is precedent.
ITSH: (608192) ACROBATICA TECNICO; (608310) ACROBATICA TEST

Record 258 of 281 - SPORT Discus

TI: The relationship between the sport team identification of basketball spectators and the number of attributions they generate to explain their team's performance

AU: Wann,-D-L; Wilson,-A-M
SO: International-sports-journal-(West-Haven,-Conn.) 5(1), Winter 2001, 43-50, Total No. of Pages: 8
PY: 2001
LE: Advanced
DE: BASKETBALL-; SPECTATOR-; IDENTIFICATION-; GROUP-COHESION; CORRELATION-; ATTRIBUTION-; MATCH-ANALYSIS; MAN-; WOMAN-; YOUNG-ADULT; ADULT-; MIDDLE-AGE
SH: (546173) BASKETBALL SPECTATORS; (988915) PSYCHOLOGY-SPECTATORS; (987325) PSYCHOLOGY-ATTRIBUTION

AB: It has been suggested that individuals are particularly likely to generate causal attributions when they are involved in situations that are personally relevant. This suggestion was tested among sport fans by having these persons complete a measure of their identification with a sport team and then assessing their attributions of a competition involving the team. As expected, highly identified fans generated a larger number of attributions than lowly identified persons and the attributions tended to be self-serving in nature.

ITSH: (546173) PALLACANESTRO SPETTATORE; (988915) PSICOLOGIA-SPETTATORI; (987325) PSICOLOGIA-ATTRIBUZIONE

CL: GV701.P4 #1820

SX: This document is available via SIRCExpress Order Number S-670281, https://secure.sportquest.com/su.cfm?articleno=S-670281&title=S-670281

Record 259 of 281 - SPORT Discus

TI: Effect of ice surface size on collision rates and head impacts in elite junior hockey.

AU: Wennberg,-R-A

SO: British-journal-of-sports-medicine-(London) 38(5), Oct 2004, 657, Total No. of Pages: 1

CN: International Symposium on Concussion in Sport (2nd : 2004 : Prague, Czech Republic).

PY: 2004

LE: Advanced

DE: HOCKEY-; ELITE-ATHLETE; SURFACE-; ICE-; MEASUREMENT-; INJURY-; RISK-; TEAM-CANADA; VIDEOTAPE-; WORLD-JUNIOR-CHAMPIONSHIP; COLLISION-; PREVENTION-; MATCH-ANALYSIS; CORRELATION-; COMPARATIVE-STUDY

SH: (464093) HOCKEY INJURIES-AND-ACCIDENTS; (464078) HOCKEY FACILITIES; (907440) FACILITIES-ARENAS-AND-ICE-RINKS

ITSH: (464093) HOCKEY-SU-GHIACCIO INFORTUNI-E-INCIDENTI; (464078) HOCKEY-SU-GHIACCIO IMPIANTI; (907440) IMPIANTI-PISTE-E-STADI-DEL-GHIACCIO

CL: RC1200 #300

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Record 260 of 281 - SPORT Discus

TI: Developing anticipation skills in tennis using on-court instruction: perception versus perception and action

AU: Williams,-A-M; Ward,-P; Smeeton,-N-J; Allen,-D

SO: Journal-of-applied-sport-psychology-(London) 16(4), Dec 2004, 350-360, Total No. of Pages: 11

PY: 2004

LE: Advanced

DE: TENNIS-; COACHING-; LEARNING-; SKILL-; ANTICIPATION-; NOVICE-ATHLETE

SH: (708118) TENNIS PERCEPTUAL-MOTOR-PROCESSES; (708045) TENNIS COACHING

AB: On-court instruction involving either Perception-action training or Perception-only training was used to improve anticipation skill in novice tennis players. A technical instruction group acted as a control. Participants' ability to anticipate an opponent's serve was assessed pre- and posttest using established on-court measures involving frame-by-frame video analysis. The perception-action and perception-only groups significantly improved their anticipatory performance from pretest to posttest. No pretest-to-posttest differences in anticipation skill were reported for the technical instruction group. The ability to anticipate an opponent's serve can be improved through on-court instruction where the relationship between key postural cues and subsequent performance is highlighted, and both practice and feedback are provided. No significant differences were observed between the perception-action and perception-only training groups, implying that either mode of training may be effective in enhancing perceptual skill in sport.

ITSH: (708118) TENNIS ABILITA-MOTORIA; (708045) TENNIS ALLENAMENTO

CL: GV706.4 P4 #50

SX: This document is available via SIRCExpress Order Number S-963513, https://secure.sportquest.com/su.cfm?articleno=S-963513&title=S-963513

Record 261 of 281 - SPORT Discus

TI: Reliability and validity of a computer based notational analysis system for competitive table tennis

AU: Wilson,-K; Barnes,-C-A
PB: In, Lees, A. (ed.) et al., Science and racket sports II, London, E & FN Spon, c1998, p. 265-268, Total No. of Pages: 4
CN: World Congress of Science and Racket Sports (2nd : 1997 : Lillishall, England).; International Table Tennis Federation Sports Science Congress (5th : 1997 : Lillishall, England).
PY: 1998
LE: Intermediate
DE: TEST-RELIABILITY; NOTATION-; COMPUTER-; TABLE-TENNIS; EVALUATION-
SH: (706310) TABLE-TENNIS TESTING-AND-EVALUATION
ITSH: (706310) TENNIS-TAVOLO TEST
CL: GV990 #34134
SX: This document is available via SIRCExpress Order Number 480700, https://secure.sportquest.com/su.cfm?articleno=480700&title=480700

TI: Evaluation of athletic performance through game analysis of tennis

AU: Woo,-S-Y; Shin,-I-S; Brown,-E-W
CA: International-Society-of-Biomechanics-in-Sports
PB: In, Sanders, R.H. and Gibson, B.J. (eds.), Scientific proceedings : ISBS '99 : XVII International Symposium on Biomechanics in Sports, June 30-July 6, 1999, Edith Cowan University, Perth, Western Australia, Perth School of Biomedical and Sports Science, Edith Cowan University, 1999, p.121-124, Total No. of Pages: 4
CN: International Symposium on Biomechanics in Sports (17th : 1999 : Perth, Western Australia).
PY: 1999
LE: Advanced
DE: TENNIS-; MATCH-ANALYSIS; THREE-DIMENSIONAL-DISPLAY-SYSTEM
SH: (708310) TENNIS TESTING-AND-EVALUATION
ITSH: (708310) TENNIS TEST
CL: QP302 #34970
SX: This document is available via SIRCExpress Order Number S-162103, https://secure.sportquest.com/su.cfm?articleno=S-162103&title=S-162103

TI: Research on home advantage in Chinese Soccer League A

AU: Xie,-H; Yin,-X; Li,-Z
SO: Sports-science-(Beijing) 18(1), 7 Jan 1998, 89-94, Total No. of Pages: 6
PY: 1998
LE: Advanced
DE: SOCCER-; COMPETITION-; HOME-ADVANTAGE; GAME-LOCATION; PSYCHODYNAMICS-; MATCH-ANALYSIS; PEOPLE'-S-REPUBLIC-OF-CHINA; ELITE-ATHLETE
SH: (576004) SOCCER ADMINISTRATION
AB: To study home advantage in soccer matches, 90 top level Chinese soccer players were surveyed by questionnaire with home-away inner experience combined with the technical statistics of home advantage in 1995 and 1996 Chinese Soccer League A. The results showed that home advantage existed in the matches of Chinese Soccer League A and had important influence on winning rate. The effects of home field environment, competition at home field, and player's inner experience difference of home and away matches are the three basic factors of home advantage.
ITSH: (576004) CALCIO AMMINISTRAZIONE

Record 265 of 281 - SPORT Discus

TI: Dialectical relationship between the attacking speed and the rate of successful attack in basketball matches.

AU: Xie,-L
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 20(2), June 1997, 90-93, Total No. of Pages: 4
PY: 1997
LE: Advanced
DE: BASKETBALL-; MATCH-ANALYSIS; STRATEGY-; SPEED-; OFFENCE-
SH: (546310) BASKETBALL TESTING-AND-EVALUATION
AB: By studying the dialectical relationship between the attacking speed and the rate of successful attack in basketball matches, it was found that with the change of the fast attacking speed to the slow speed, the rate of successful attack tended to decrease gradually. But in the process of its decreasing, it went up twice in the range of position attack. The requirements of a match are to fight a quick battle to force a quick decision on strategy and to combine the fast attack with the slow on tactics.
ITSH: (546310) PALLACANESTRO TEST

Record 266 of 281 - SPORT Discus

TI: Research on the attaching speed and attacking success rate of Chinese men's basketball team in XII world basketball championship

AU: Xie,-L
SO: Sports-science-(Beijing) 17(2), Mar 1997, 36-40, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: MATCH-ANALYSIS; OFFENCE-; SPEED-; SHOOTING-; BASKETBALL-; PEOPLE'-S-REPUBLIC-OF-CHINA; WORLD-CHAMPIONSHIP; 1995-
SH: (546180) BASKETBALL STRATEGY
AB: The attacking speed in basketball here refers to the speed of attacking process, with ball-catching as affecting prerequisite and technical and tactical level as key affecting factors. The finish of attack has no effect on attacking speed. During attacking, faults, violation and fouls decrease the attacking success average, while foul defense and shots increase the success average. The main reasons of low attacking success average of the Chinese team were lower shooting rate, especially lower close shooting rate, and more faults, violation and fouls in the front court. Along with the attacking speed from fast to slow, the success average of attacking tended to decrease. Yet during the process of getting down of success average, there were still two pick ups when they were in position attack.
ITSH: (546180) PALLACANESTRO TATTICA

Record 267 of 281 - SPORT Discus

TI: The technical features in today's race walking

AU: Xu,-S; Li,-J; Lu,-Z
SO: Sports-science-(Beijing) 17(1), Jan 1997, 40-43, Total No. of Pages: 4
PY: 1997

LE: Advanced
DE: RACE-WALK; RULE-; TECHNIQUE-; SKILL-; EVALUATION-; MATCH-ANALYSIS; WORLD-CUP; 1995-
SH: (726192) RACE-WALKING TECHNIQUES-AND-SKILLS
AB: Techniques of the athletes who won the first eight places in men' 20km and 50km and women's 10km race walk at the 1995 IAAF World Cup were qualitatively and quantitatively analyzed by mean of sports biomechanics and statistics, based on which ten technical feature that are in conformity with the new definition of race walking were revealed.
ITSH: (726192) MARCIA TECNICO
SX: This document is available via SIRCExpress Order Number 417698, https://secure.sportquest.com/su.cfm?articleno=417698&title=417698

Record 268 of 281 - SPORT Discus

TI: An analysis of the playing patterns of the Japan National team in the 1998 World Cup for soccer

AU: Yamanaka,-K; Nishikawa,-T; Yamanaka,-T; Hughes,-M-D
PB: In Spinks, W. (ed.), Science and football IV, London, Routledge, 2002, p.101-105, Total No. of Pages: 5
CN: World Congress of Science and Football (4th : 1999 : Sydney, Australia).
PY: 2002
LE: Advanced
DE: SOCCER-; JAPAN-; MATCH-ANALYSIS; ELITE-ATHLETE
SH: (576045) SOCCER COACHING; (902050) COACHING-EVALUATION
ITSH: (576045) CALCIO ALLENAMENTO; (902050) ALLENAMENTO-VALUTAZIONE

Record 269 of 281 - SPORT Discus

TI: Measurement of take-off forces in ski jumping competition

AU: Yamanobe,-K; Watanabe,-K
SO: Japanese-journal-of-biomechanics-in-sports-and-exercise-(Tokyo) 3(4), 1999, 277-286, Total No. of Pages: 10
PY: 1999
LE: Advanced
DE: SKI-JUMPING; MATCH-ANALYSIS; KINETICS-; TAKE-OFF; FORCE-; FORCE-PLATE; CORRELATION-; DISTANCE-; MAN-
SH: (500027) SKI-JUMPING BIOMECHANICS; (946450) BIOMECHANICS-KINETICS
AB: The purpose of this study was to identify the relation between the force production during take-off by ski jumpers and their performance. The force measuring system, which constructed under the take-off platform was used to measure the normal forces exerted during take-off by ski jumpers. This field research was conducted in a competition "FIS Continental Cup Asia Series NTT Cup Summer Jumping Games" in 1996.Three variables were analyzed as follows: the average forces (F'6-0m), the peak force value (FZpeak) and the net impulse (I6-0m) of the force measured from the last 6 m of the take-off platform. These variables were significantly correlated to the distance of ski jumping. Also these variables were compared between two groups: the 1-10 placers (longest 10) and the 41 - 50 placers (shortest 10) . All the variables obtained by the longest 10 group showed significantly higher value than those of the shortest 10 group. These results indicate that the force production during the take-off has some effects on the ski jumping performance. It was found that the force curves obtained from the same subject were closely similar to each other. Comparison was conducted between two ski jumpers about their ways of force production. These two ski jumpers had same amount of the impulse of the force, but their ways of force production were very different.
ITSH: (500027) SALTO-CON-GLI-SCI BIOMECANICA; (946450) BIOMECCANICA-CINOSIOLOGIA
CL: QP302.P4 #400
SX: This document is available via SIRCExpress Order Number S-666138, https://secure.sportquest.com/su.cfm?articleno=S-666138&title=S-666138

Record 270 of 281 - SPORT Discus

TI: A psychological analysis about the affecting action of the basketball players

AU: Yang,-X-B
SO: Journal-of-Hubei-sports-science 19(4), 2000, 34-36, Total No. of Pages: 3
PY: 2000
LE: Intermediate
DE: BASKETBALL-; MATCH-ANALYSIS; EMOTION-; PSYCHOLOGY-
SH: (546147) BASKETBALL PSYCHOLOGY

AB: This essay probes into the form of the effecting action of the player on the basketball match sports psychology. It points out that the observation and the thinking are the foundation of the affecting action of the players. The players can only won the match when they based on this.
ITSH: (546147) PALLACANESTRO PSICOLOGIA

Record 271 of 281 - SPORT Discus

TI: Measuring running speed using photocells

AU: Yeadon,-M-R; Kato,-T; Kerwin,-D-G
SO: Journal-of-sports-sciences-(London) 17(3), Mar 1999, 249-257, Total No. of Pages: 9
PY: 1999
LE: Advanced
DE: RUNNING-; SPEED-; SPEEDOMETER-; TIMING-; ACCURACY-; EVALUATION-
SH: (728310) RUNNING TESTING-AND-EVALUATION; (977300) PHYSICAL-FITNESS-TESTING-SPEED-TESTING; (996200) TESTING-AND-MEASUREMENT-MEASUREMENT

AB: Photocell timing systems are used routinely to measure running speeds. In this study, the accuracy of such systems was evaluated using centre of mass speed estimates from three-dimensional video analysis as criteria. One subject ran at five nominal speeds (5-9 m.s-1) for each of five separations (1.6-2.4 m) between consecutive photocells. Running speeds were calculated from the photocell data using single beam and double beam systems. For single beam systems, the start of the first break of a beam and the start of the longest break of a beam were used as trigger criteria. For double beam systems, the first occurrence of both beams being broken and the start of the longest double break were used as trigger criteria. Root mean square speed errors were smaller for the double beam systems. The longest break criterion gave smaller root mean square errors than the first break criterion. In general, errors in speed were smaller for greater photocell separations. An error of 0.1 m.s-1 was achieved using a single beam system set at hip height with a longest break criterion for photocell separations of around two stride lengths. The advantage of using a double beam system is that it achieves this accuracy without the need to adjust photocell separation for different stride lengths.
ITSH: (728310) CORSA TEST; (977300) CONDIZIONE-FISICA-TEST-TEST-DI-VELOCITA; (996200) TEST-MISURAZIONE
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number S-45693, https://secure.sportquest.com/su.cfm?articleno=S-45693&title=S-45693

Record 272 of 281 - SPORT Discus

TI: Pre-flight characteristics of Hecht vaults

   (Caracteristiques de la preparation du saut du brochet.)
AU: Yeadon,-M-R; King,-M-A; Sprigings,-E-J
SO: Journal-of-sports-sciences-(London) 16(4), May 1998, 349-356, Total No. of Pages: 8
PY: 1998
LE: Advanced
DE: GYMNASTICS-; BIOMECHANICS-; HECHT-VAULT; VIDEOTAPE-; VISUAL-FEEDBACK; COMPARATIVE-STUDY; ELITE-ATHLETE
SH: (656027) GYMNASTICS-VAULTING BIOMECHANICS

AB: This study reports the techniques used by gymnasts to perform the Hecht vault and compares them with techniques used for the handspring somersault vault (Takei and Kim, 1990). Our main aim was to establish how the pre-flight characteristics of the Hecht vault influence post-flight performance. Data were obtained on 27 elite gymnasts performing the Hecht vault at the 1993 Canadian National Championships using two-dimensional video analysis with the

direct linear transformation (DLT) technique. The maximum height reached by the mass centre during post-flight was significantly correlated (P is less than 0.001) with the vertical velocity of the mass centre and the body angle at horse contact. The backwards rotation of the body was significantly correlated (P = 0.015) with the shoulder angle at horse contact. The competition score was significantly correlated (P = 0.043) with the body angle at horse contact and was also related to the maximum height of the mass centre during post-flight. For the Hecht vault, the gymnasts had longer, lower and faster pre-flights with slower rotation at horse contact compared with the handspring somersault vaults.
ITSH: (656027) VOLTEGGIO BIOMECANICA
CL: RC1200 #700
SX: This document is available via SIRCExpress Order Number 436327, https://secure.sportquest.com/su.cfm?articleno=436327&title=436327

TI: Forecasting the 2003 Rugby World Cup

AU: Yelas,-S; Clarke,-S
PB: In Morton, R.H. (ed.), Massey University, Proceedings of the Seventh Australasian Conference on Mathematics and Computers in Sport, Palmerston North, N.Z., Massey University, 2004, p.270-277, Total No. of Pages: 8
CN: Mathematics and Computers in Sport (7th : 2004 : Massey University, N.Z.)
PY: 2004
LE: Advanced
DE: RUGBY-UNION; MATCH-ANALYSIS; STATISTICS-; MATHEMATICAL-MODEL; WORLD-CUP; 2003-
SH: (574110) RUGBY-UNION MATHEMATICS; (574305) RUGBY-UNION TECHNOLOGY - COMPUTER-APPLICATIONS
AB: A simple forecasting model was built to predict the results of each game and the tournament in the 2003 Rugby World Cup. An exponential smoothing technique was optimised on all 566 games played between the 20 World Cup teams from 1996. The model predicted the winning team, the winning margin and the probability of a win. A simulator used these predicted probabilities to calculate a team's overall chances of winning or placing in the tournament. Predictions were regularly updated on our web site www.swin.edu.au/sport. The model selected the correct winner in 46 of the 48 games, and the predicted margins were used for profitable gambling.
ITSH: (574110) RUGBY-UNION MATEMATICA; (574305) RUGBY-UNION TECNOLOGIA - APPLICAZIONI-INFORMATICHE

TI: Game analysis of in-play-time and out-of-play-time in The Davis Cup

AU: Yoneyama,-F; Watanabe,-H; Oda,-Y
CA: IOC-World-Congress-on-Sport-Sciences-5th-:-1999-:-Sydney,-Australia; Australian-Conference-of-Science-and-Medicine-in-Sport-1999-:-Sydney,
PB: In, Fifth IOC World Congress on Sport Sciences : book of abstracts, Canberra, Sports Medicine Australia, 1999, p.204
URL: http://www.ausport.gov.au/fulltext/1999/iocwc/abs204b.htm
PY: 1999
LE: Advanced
DE: TENNIS-; DAVIS-CUP; MATCH-ANALYSIS; TIME-OUT; REST-; TRAINING-LOAD
SH: (708312) TENNIS TRAINING-AND-CONDITIONING; (708310) TENNIS TESTING-AND-EVALUATION
ITSH: (708312) TENNIS ALLENAMENTO-E-CONDIZIONAMENTO; (708310) TENNIS TEST

The " Continuous Play and Rest Period " time in the Rules of Tennis have been modified in recent years. The 1995 rule modification shortened five seconds in the out-of-play-time. This change of time seemed to effect the performance of the tennis players. The aim of our study was to clarify the time phases of the game process in three men's singles matches of the 1996 The Davis Cup in Japan.

All games were recorded by an eight millimeter video camera. The in-play-times and out-of-play-times were calculated manually by a stopwatch. The data of the analysis was obtained from three Davis Cup matches. The samples gathered were 717 in-play-times and 607 out-of-play-times. The average ± standard deviation for the in-play-time was 6.6±5.3 seconds while the average ± standard deviation for the out-of-play-time was 21.6±5.3 seconds. Both were measured during interval points. These results indicated that the training program for the improvement of continuous capacity of intermittent high-intensity-exercise was useful.

Record 275 of 281 - SPORT Discus

TI: Analysis of men's 1000 m race-pattern in 1993 world sprint speed skate championships

AU: Yuki,-M; Hirano,-T; Morioka,-Y; Ae,-M
SO: Japanese-journal-of-biomechanics-in-sports-and-exercise-(Tokyo) 3(4), 1999, 270-276, Total No. of Pages: 7
PY: 1999
LE: Advanced
DE: SPEED-SKATING; 1000-M.; MATCH-ANALYSIS; KINEMATICS-; SPEED-; PATTERN-; CINEMATOGRAPHY-; ELITE-ATHLETE; MAN-
SH: (468027) SPEED-SKATING BIOMECHANICS; (946400) BIOMECHANICS-KINEMATICS
AB: The purpose of this study was to investigate the characteristics of 1000 m race-patterns for an elite speed skaters at the World Sprint Championship 1993 in IKAHO, Japan. Twenty-eight skaters participated in men's 1000 m races were videotaped (60 fields/s) with five panning VTR cameras. Mean skating speed, skating-cycle frequency and-cycle length at twenty sections (about 50 m each) were measured. Skating speeds of both inner and outer starting lanes were quickly increased until they reached the maximal speed around 300 m marks, then slightly decreased around 700 m marks and rapidly fell down to the finish. There were close relationships between skating speeds in the second half of the races and finishing time. By using mean value of the rate of decline (%) in skating velocity defined as (1 - (1st lap time/2nd lap time) X 100, race-pattern for all skaters were classified into two types, so that it should be suggested that small increase in skating-cycle frequency at 600 m marks is important to keep their skating speeds in the last stage of the races.
ITSH: (468027) PATTINAGGIO-DI-VELOCITA BIOMECANICA; (946400) BIOMECCANICA-CINEMATICA
CL: QP302.P4 #400
SX: This document is available via SIRCExpress Order Number S-666137, https://secure.sportquest.com/su.cfm?articleno=S-666137&title=S-666137

Record 276 of 281 - SPORT Discus

TI: Research on computer entry system for international table tennis competitions

AU: Zhang,-Y
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 20(1), 1997, 90-94, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: TABLE-TENNIS; COMPUTER-PROGRAM; MANAGEMENT-SYSTEM; MATCH-ANALYSIS
SH: (706310) TABLE-TENNIS TESTING-AND-EVALUATION
AB: The functions of the computer entry system for the international table tennis competitions were stated. After observing its operation and analyzing the data obtained in the 12th ATTC and the 43rd WTTC, the technical characteristics of the system, the theoretical basis and the important reference for further designing the same sort of computer system were indicated.
ITSH: (706310) TENNIS-TAVOLO TEST
SX: This document is available via SIRCExpress Order Number 453950, https://secure.sportquest.com/su.cfm?articleno=453950&title=453950

Record 277 of 281 - SPORT Discus

TI: Exercise biomechanical analysis of short corner skills in Chinese female hockeyers.)

AU: Zhao,-F; Zhou,-X-L; Wang,-Y; Wang,-Y-H
SO: Journal-of-Beijing-University-of-Physical-Education-(Beijing) 23(4), 2000, 482-484;504, Total No. of Pages: 4
PY: 2000
LE: Advanced
DE: FIELD-HOCKEY; BIOMECHANICS-; WOMAN-; THREE-DIMENSIONAL-DISPLAY-SYSTEM; SKILL-; ELITE-ATHLETE
SH: (554027) FIELD-HOCKEY BIOMECHANICS
AB: The system for collecting exercise information at the real time and feeding back in time by computer was prepared. In China this is taken the lead in applying the analysis method to feed back the moving tableaus on the spot to the coaches by contrast etc. Using the three-dimension video analysis system to analyze the attacking short corner skills in female champion field hockey team of the world and the national team of China, the technical model for excellent attacking short corner skills was established. In the recent year, the Chinese female hockey team has made great progress in their technical level of attacking short corner skills. In the qualification rounds of the 27th Olympic Games the success ratio of attacking short corner skills has increased from 2% (in the 25th Olympic Games) and 4% (in the 26th Olympic Games) to 7.5%. And in the 27th Olympic Games the success ratio of short corner skills reached the anticipative 15%. The number of short corner goals accounted for 100% of the total number of goals.
ITSH: (554027) HOCKEY-SU-PRATO BIOMECANICA
CL: GV201 #5440
SX: This document is available via SIRCExpress Order Number S-787374, https://secure.sportquest.com/su.cfm?articleno=S-787374&title=S-787374

Record 278 of 281 - SPORT Discus

TI: A preliminary conception of system of football double chief judges

AU: Zheng,-Y; Ji,-F-P
SO: Journal-of-Wuhan-institute-of-physical-education-(Wuhan,-P.R.China) 36(1), 2002, 80-83, Total No. of Pages: 4
PY: 2002
LE: Advanced
DE: SOCCER-; OFFICIATING-; SYSTEMS-ANALYSIS; MATCH-ANALYSIS
SH: (576117) SOCCER OFFICIATING
AB: In view of disadvantages of contemporary system of single chief judge and in combination of the present situation of the matches, system of double chief judges and preliminary conception of its application are proposed.
ITSH: (576117) CALCIO ARBITRAGGIO

Record 279 of 281 - SPORT Discus

TI: Lower body mechanics during the baseball swing

AU: Zou,-L; Zhon,-J
SO: Journal-of-Guangzhou-Physical-Education-Institute-(Guangzhou,-China) 17(4), 1997, 55-59, Total No. of Pages: 5
PY: 1997
LE: Advanced
DE: BASEBALL-; BIOMECHANICS-; LEG-; STROKE-; TECHNIQUE-; BATTING-; GROUND-REACTION-FORCE; MOVEMENT-; EVALUATION-
SH: (544027) BASEBALL BIOMECHANICS
AB: There are two types of techniques for the baseball swing. One emphasizes the rotational movement of the body. The other emphasizes the combination of rotational and linear movement. In this study, 3-D motion data and ground reaction forces were collected and analyzed using a high speed video analysis system and two force plates during the baseball swing for two groups of hitters. The results showed that the forward linear movement of the hitter combined with the rotational movement of the hip provide a foundation for generating high bat speed and quick start. It is to be used for benefit of improving the techniques of baseball swing.
ITSH: (544027) BASEBALL BIOMECANICA

Record 280 of 281 - SPORT Discus

TI: Match analysis

CA: Nike-Sports-Research-Laboratory
SO: Sport-research-review-(Beaverton,-Or.) Fall 1997, 1-4, Total No. of Pages: 4
PY: 1997
LE: Advanced
DE: SQUASH-RACQUETS; AUSTRALIAN-FOOTBALL; SOCCER-; RUGBY-UNION; MATCH-ANALYSIS; SKILL-; COACHING-; ENERGY-METABOLISM; EFFICIENCY-
SH: (540118) TEAM-SPORTS PERCEPTUAL-MOTOR-PROCESSES; (902160) COACHING-PERCEPTUAL-MOTOR-PROCESSES
ITSH: (540118) SPORT-DI-SQUADRA ABILITA-MOTORIA; (902160) ALLENAMENTO-APPRENDIMENTO-PERCETTIVO-MOTOR
SX: This document is available via SIRCExpress Order Number 457545, https://secure.sportquest.com/su.cfm?articleno=457545&title=457545

Record 281 of 281 - SPORT Discus

TI: Physiologic changes during soccer play.

SO: Pediatric-exercise-science-(Champaign,-Ill.) 14(3), Aug 2002, 219-220, Total No. of Pages: 2
PY: 2002
LE: Advanced
DE: HEART-RATE; PREPUBESCENT-; SOCCER-; MATCH-ANALYSIS; LACTATE-; CHILD-; COMPARATIVE-STUDY
SH: (576033) SOCCER CHILDREN; (576310) SOCCER TESTING-AND-EVALUATION; (979400) PHYSIOLOGY-CARDIOVASCULAR-HEMODYNAMICS; (980350) PHYSIOLOGY-ENERGY-METABOLISM-LACTATE
ITSH: (576033) CALCIO BAMBINI; (576310) CALCIO TEST; (979400) FISIOLOGIA-CARDIOVASCOLARE-CIRCOLAZIONE-DEL-SANGUE; (980350) FISIOLOGIA-METABOLISMO-ENERGETICO-LATTATO
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SX: This document is available via SIRCExpress Order Number S-840486, https://secure.sportquest.com/su.cfm?articleno=S-840486&title=S-840486