

CONTENTS

<i>List of figures</i>	vii
<i>List of tables</i>	xi
<i>Acknowledgements</i>	xiii
1 Introduction	1
2 Assessing skill learning and performance	24
3 Anticipation and decision-making skills	43
4 Match analysis	70
5 Aerobic performance	103
6 Anaerobic and musculoskeletal performance	133
7 The meaning and measurement of body composition	170
8 Emerging technologies	200
<i>Index</i>	218

FIGURES

- 1.1 An ergonomics model for the analysis of soccer (adapted from Reilly, 2005) 6
- 1.2 Comparison of post-season and pre-season vertical jump performance in a group of American Football players (drawn from data of Salci et al., 2007) 8
- 1.3 A GPS receiver commonly used in field sports to measure work rate and cardiac responses to exercise (courtesy of GPSports Ltd) 12
- 1.4 Outline of the major factors to be taken into account when acquiring a computerised match-analysis system (redrawn from Carling et al., 2005) 19
- 2.1 Two typical performance curves showing increases in performance on a soccer skills test for shooting. The first curve **(a)** is a negatively accelerated, gradually increasing learning curve showing a rapid improvement in performance at first followed by a general 'levelling off', during which improvements are relatively slow. The results of a retention test to assess learning are highlighted on the right-hand side. The second curve **(b)** is a sigmoid function learning curve showing a slow gradual increase followed by a sharp improvement in performance and then a gradual slowing down in performance gains 26
- 2.2 An integrated model of qualitative analysis (adapted from Knudson and Morrison, 1997) 31
- 2.3 Some typical angular velocity data for the thigh and shank during a soccer kick. The four stages of the kick are marked on the graph with ball-foot contact occurring at the end of Stage 3 just as the shank reaches peak angular velocity (from Lees, 2003) 34

2.4	Angle–angle diagrams showing changes in range of motion at the hip, knee and ankle following successive practice sessions designed to improve kicking performance in soccer (from Hodges, et al., 2005)	36
2.5	A typical frame of data involving a rugby passing action captured using the Simi Motion analysis software (images created using the Simi Motion system)	37
3.1	An illustration of some temporal occlusion conditions in a soccer penalty-kick simulation	46
3.2	The types of spatial occlusion conditions that may be employed in soccer penalty-kick simulations	49
3.3	The viewing perspective most often employed in the recognition paradigm	51
3.4	An attacking sequence of play in soccer presented as a point-light display (from Williams et al., 2006)	52
3.5	The final frame of action typically used in the situational probabilities paradigm (from Williams and Ward, 2007)	54
3.6	The experimental set-up used by Vaeyens et al. (2007a, 2007b) to assess decision-making skills in soccer	55
3.7	The different perceptual–cognitive skills and how they relate to anticipation and decision-making skills (from Williams and Ward, 2007)	56
3.8	The Mobile Eye System being employed to collect data in soccer	58
4.1	The coaching cycle highlighting the importance of observation and analysis (adapted from Carling et al., 2005)	71
4.2	A schematic tally sheet that could be used to determine the frequency count of passes from central areas into the penalty area or shots on goal	74
4.3	The interface of the Sportscodel match-analysis system (courtesy of Sportstecinternational)	78
4.4	The AMISCO Pro Match Viewer software (courtesy of Sport-Universal Process)	80
4.5	Schematic pitch representation of attacking routes and number of actions used by a team prior to three tries (data courtesy of Virtual Spectator)	82
4.6	Schematic pitch representation of various match actions (courtesy of Virtual Spectator) of an elite soccer player	84
4.7	Schematic pitch representation of zone coverage of an elite Australian Rules footballer (courtesy of Virtual Spectator)	85
4.8	Schematic pitch representation of pass distribution of an elite soccer player (courtesy of Virtual Spectator)	85

4.9	An example of player tracking using the Dvideo match-analysis system (reprinted with permission from the <i>Journal of Sports Science and Medicine</i> , 2007)	89
4.10	A strategically placed antennae receiver of the LPM Soccer 3D® system placed above the goal area (courtesy of Inmotio)	92
4.11	GPS receivers worn in a training session by English Premier League team Middlesbrough Football Club (courtesy of GPSports)	92
4.12	Relative distances covered by an elite Rugby Union player according to categories of activity divided according to speed (in metres per second) (data courtesy of GPSports)	96
4.13	Analysis of recovery time between high-intensity actions during a period of three matches in five days in English professional soccer teams (data adapted from Odetoyinbo et al., 2007)	98
5.1	The factors influencing endurance capability of games players are both central and peripheral	104
5.2	Air expired is collected into Douglas bags for determination of $\dot{V}O_2$	110
5.3	Maximal exercise test using online gas analysis for determination of $\dot{V}O_{2max}$ in an international football player	110
5.4	The blood lactate response to incremental exercise, with 3-mM and 4-mM 'thresholds' indicated by the arrows. Corresponding heart-rate values are shown in the upper lines (reproduced from Reilly, 2007 with permission)	113
5.5	Average $\dot{V}O_{2max}$ values of international French soccer players from U/15 to U/21 level (adapted from Carling, 2001)	122
5.6	Area prepared for the 30–15 Intermittent Fitness Test (30–15IFT) (Buccheit, 2008)	123
5.7	The course for the Interval shuttle run test used by Elferink-Gemser et al. (2004) for assessment of young field-hockey players	126
6.1	The anatomical structures involved in contraction of skeletal muscle (from Reilly, 1981)	137
6.2	The force–velocity relationship of muscle under eccentric, isometric and concentric conditions	138
6.3	The SMARTJUMP jumping mat (courtesy of Fusion Sports)	142
6.4	The original Wingate Anaerobic test was performed on a cycle ergometer. The print-out on the left indicates power output in watts for each second throughout the test.	144
6.5	A junior athlete sprints up a stairway, contacting two mats linked to a timing device	145
6.6	A repeated-sprint ability test can be performed indoors when a suitable runway length is available	148

6.7	A games player performs a zig-zag agility test	151
6.8	Field tests for assessment of fitness of female hockey players incorporating dribbling (from Reilly and Bretherton, 1986)	155
6.9	Field tests for assessment of fitness of female hockey players incorporating speed and accuracy (from Reilly and Bretherton, 1986)	156
6.10	Isokinetic dynamometry is used for assessment of strength of the knee extensors in this set-up	161
7.1	The expanding universe of physiques in international Rugby Union (from Olds, 2001)	175
7.2	Subject is in water tank prior to (top) and during (bottom) immersion for weighing underwater	180
7.3	Multi-frequency bioelectric impedance is applied to an athlete lying supine for determination of body water, from which percentage body fat is estimated	185
7.4	Skinfold thicknesses at subscapular (left) and supra-iliac (right) sites are recorded	187
7.5	An athlete is supine on the bed for assessment using dual-energy X-ray absorptiometry. Body fat, bone mass, bone mineral content and bone mineral density can be determined from a whole-body scan	192
7.6	Output of assessment using DXA	193
8.1	The OmegaWave Sport and STAR+ system (courtesy of OmegaWave Technologies, LLC)	202
8.2	A head-mounted display for immersion in a virtual environment (courtesy of www.5dt.com)	207
8.3	Immersion in the Virtual Football Trainer Cave (courtesy of University of Michigan Virtual Reality Lab)	207

TABLES

1.1	Reasons for assessing performance in sports	9
1.2	Fitness tests and national squad performance standards for netball (Grantham, 2007)	10
1.3	The various components of performance and order of testing commonly employed in international Rugby Union (adapted from Tong and Wiltshire, 2007)	16
2.1	A template or framework that may be used to facilitate systematic qualitative analysis of the soccer kick	29
3.1	Variations in error made across the four temporal occlusion conditions as a proportion of the total errors (in %) (from Williams and Burwitz (1993)	47
3.2	A summary of the published research examining the training of anticipation and decision-making skills in field sports	61
4.1	A simple tally sheet to record frequency counts of successful and unsuccessful actions	73
4.2	Some of the computerised video analysis systems used in field sports currently available on the market	77
4.3	Source of goals in 2006 Soccer World Cup (Breen et al., 2006)	81
4.4	Ratios for the number of attempts at goal to goals scored from open play and set plays at soccer World Cup 2002 and 2006 (Bell-Walker et al., 2006)	86
4.5	A list of the commercial player tracking systems used in field sports currently available on the market	88
4.6	Impact intensity zone data for a professional Australian Rugby Union player (data supplied courtesy of GPSports)	98
5.1	Maximal oxygen uptake of elite soccer players (from Reilly and Doran, 2003; Svensson and Drust, 2005; Stølen et al., 2005; Gil et al., 2007)	109

5.2	Examples of some selected soccer-specific field tests of aerobic performance (Svensson and Drust, 2005)	125
6.1	Examples of some soccer-specific field tests of anaerobic performance	141
6.2	Examples of mean fitness test results for various components of anaerobic performance in elite Rugby League players (data cited in Breivik, 2007)	157
7.1	The relationship between body mass index (BMI) and health-related weight categorisation according to the World Health Organisation	172
7.2	Somatotype and estimated body fat percentage in different groups of male games players	177
7.3	Different methods of body composition assessment	179
7.4	Guidelines for assessing skinfold thicknesses at different sites	188
7.5	Estimated muscle mass in various groups of male games players and reference groups	191
7.6	Summary of whole-body, femoral neck and lumbar spine BMD values for cross-sectional studies in young adult eumenorrhoeic females (from Egan et al., 2006a)	195