Football Science VII: the International Conference in Japan, 2011

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The most positive aspects of this quadrennial conference were the productive mix of the various football codes and open access to videos of all 41 invited lectures. Talent Development: relative age effect, developing young players, sprint performance, draft camps. Training & Monitoring: load management, heart rate, perceived exertion, sport-science support, FIFA's "The 11", high-intensity sessions, complex skills, recovery, throw-ins, sleep and alcohol. Match and Movement Analysis: zone-oriented defense, game phases, tactical interactions, dynamical systems theory, collective motion, defensive strength map, dominant region, position-specific movements, acceleration phases, taking a dive, penalty kicks, ball possession, World-Cup game-winners. Tests & Technology: anthropometric characteristics, the Yo-yo test, skill tasks, fast vs slow players, flexibility, adjusting performance indicators, sample size, perceptions of sport science, the red team wins. KEYWORDS: AFL, association football, elite athletes, league, match analysis, rugby, soccer, tests, training.

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Staff from the Nagoya University proved friendly and professional in their hosting of the World Congress on Science and Football in Japan, the seventh in the series. Among the 350 or so attendees were some of the most influential researchers in the various football codes. As always, the congress was an excellent opportunity to share recent work and ideas. We're all looking forward to next year's World Conference on Science and Soccer in Ghent, Belgium!

The conference organizers have very generously uploaded videos of all the symposia to YouTube. To view each of the 41 invited presentations, go to the end of this article, where you will find a list we have copied from the official program and linked to each video.

In this report we have referred to all European football as *soccer*. The summary of each presentation includes the names of the first one or two authors and the first few words of the title of the abstract, to allow you to find it when the abstracts are eventually published. You can also get a scanned copy of selected abstracts from author MB (who attended the conference) or author WGH (who did not).

Talent Development

A few presentations focused on the **relative age effect**–the over representation of players born in the first half of the year in teams. While the effect occurs in **all sports**, the impact on anthropometric and performance measures is still unclear [Leite, Relative Age Effect in Football…; Simpson, Is the Relative Age Effect Influenced...; Fernley, Relative Age Effects in Elite Junior…].

A presentation on the application of science to **developing young players** in an English premier league **soccer** club listed all the usual sensible strategies [Iga, The Application of Science…]. The training program takes into account age of peak height velocity and prediction of adult stature. The theoretical background is seducing, but how it is implemented on a daily basis is another question.

In support to the concept of **individualizing training** based on growth and maturation, Mendez-Villanueva presented data on spontaneous periods of accelerated improvement in physical fitness in youth **soccer** players [Physical Fitness Trainability…]. Soccer-specific training tends to improve aerobic fitness in prepubertal boys, whereas more mature players show improvements in neuromuscular-related fitness.

The changes in **sprint performance** with

growth in young **soccer** players are associated with different stride patterns: the younger improve more their performance via stride length, while the older, via stride rate [Poon, Age-related Differences in Sprint Performance…]. So what should we train: the parameter that is already improving naturally or the other parameter?

Age-related differences in **repeated-sprint** ability parallel differences in several measures of fitness in **soccer** [Spencer, Fitness Determinants of Repeated-sprint…]. To optimize the development of repeated-sprint ability, the author suggested that training could therefore focus on different aspects of fitness at different ages. This strategy still lacks evidence, however.

After surveying the available evidence, Dawson concluded in a rather cool presentation that performance in tests at rookie **draft camps** is not a consistent predictor of future career success in various **team sports** [Draft Camps and Combines…].

Training and Monitoring

Players for the **Australian-rules** (AFL) **football** club Essendon benefit from a "system of **load management** and fatigue monitoring" using psychological, hormonal and neuromuscular measures, all of which contribute to the overall picture of the players' shape. [Cormack, Load and Fatigue Monitoring…]. The interesting statistical approach is based on a moving average of each measure in relation to its smallest important change.

On similar lines, Buchheit [Monitoring Changes in Performance…] showed that decreases in exercise heart rate and increases in **heart-rate variability** can track improvements in maximal aerobic speed in young **soccer** players, yet opposite changes in these indices are not predictive of performance impairment.

Perceived exertion in training sessions was also touted as a useful monitoring approach in **rugby**, in spite of concerns that the impacts in this sport would compromise the accuracy of the measure [Coutts, Efficacy of Using Session-RPE…].

Examples of **sport-science support** to coaches and players were shown for elite **rugby union** [Gill, Current Approaches to Sport Science… (the abstract has no useful information)] and **soccer** [Dijk, Training and Performance Management…]. While everything tends to get monitored, controlled and measured by an increasing number of staff in the Bayern München soccer club, the All Blacks are going in the opposite direction with much stronger relationships and communication between a reduced (but more involved) number of staff. The All Blacks always win (the World Cup excepted, but hopefully not this year), so which approach is better?

FIFA's **injury-prevention** training program ("The 11") and a modified version of it performed one or twice a week for 6 months reduced injuries and improved some aspects of fitness in comparison with control training in a trial of 182 Japanese collegiate **soccer** payers [Saho et al., The Efficacy of The 11…].

The importance of high-intensity aerobic training to develop aerobic fitness in young **soccer** players was emphasized by Mujika. He presented an interesting (but not new) case study of a young soccer player who managed to improve Yo-Yo performance by 32% in 10 **high-intensity sessions** [Practical Aspects of High Intensity Training…].

In a randomized controlled trial of 34 male **soccer** players (age 12-14), 10 wk of training of **complex skills** produced greater improvements in several test measures than the control traditional training [Ashker & Abdelkader, Impact of Developing Simplex…]

In **Aussie-rules football** and **rugby league**, Coutts has found that "subtle changes in training load, different periodization strategies and the duration between matches can affect player **recovery** and subsequent performance" and that "72-h period following matches is critically important for ensuring appropriate recovery for the next game". [Training Factors Affecting…]. He recommends a system for planning and monitoring training at the level of team and individual player. This was the best presentation of all, in the opinion of the author of this article (MB) who attended the conference.

A **soccer** player was trained to increase (by an impressive 3.9 m) the distance he could throw the ball in run-up **throw-ins** with a staggered stance [Glynn & Kuitunen, Using Motion Analysis…]. More training and research should be done in his area. Unfortunately the abstract reports only on the changes in the player's kinematics, not on how the training was done.

A study of the impact of **sleep** deprivation and **alcohol** consumption on post-match recov-

ery in **rugby league** was presented, and guess what? It's not good for your peak power the following day. You knew it, but now you have evidence to show your players that they should go home after the game! [Duffield, Sleep Deprivation and Alcohol…].

Match and Movement Analysis

In a study of **zone-oriented defense**, Tenga used a case-control analysis to compare 203 possessions that resulted in goals with 1688 randomly chosen possessions that didn't. He found that imbalanced defensive pressure had little effect, but imbalanced backup and cover were 7.5 and 48 times more likely to result in a conceded goal in the Norwegian **soccer** league [Zone-oriented Defense…]. This original-research study is the first choice of the absentee author (WGH).

The performance physiologist of Bayern München identified four **game phases** in **soccer**: own team in possession, losing possession, opposition in possession, and regaining possession [Dijk, Training and Performance Management…]. Technical, tactical, physical and mental requirements of each player in each phase depend on the game plan and the position of the player. He uses the LPM Soccer 3D System to monitor the players' activity patterns and advanced video-computerized systems to follow the interactions between the players. "Science and innovations are important… to keep the winning edge."

Now that technologies are available to track individual players at high spatial and temporal resolution in a match, there are new possibilities for **analyzing tactical interactions** in **soccer**, such as symmetry breaking processes in player dyads and attacking/defensive team configurations [Lemmink and Frenkin, Tactical Match Analysis…; see also Dijk's presentation above]. **Dynamical systems theory** was promoted as a relevant framework with tools that can cope with such data. Duarte et al. have made a start by deriving "**collective motion variables**" representing various aspects of playing patterns in a single match [In Search of Dynamical Patterns…]. Xie et al. presented a similar limited case study of a "**defensive strength map**" based on distance between attackers and defenders [A Study on Quantitative Evaluation…].

Some of the information is lost in translation, but Taki & Hasegawa seem to be onto something interesting in their use of time and velocity data to map a **soccer** player's "**dominant region**": a region where the player can arrive at earlier than any other players [A Method for Game Analysis…]. When somehow aggregated over all players in each team, there was an obvious pattern favoring the winning team in the one game that was analyzed. In their next abstract they somehow made geometric shapes out of the players' positions, but the method and the result are inscrutable [An Evaluation Method…]. It would great if this approach could be used in real-time or near real-time to provide feedback on tactical strategies.

An analysis of movements of 37 elite **rugby league** players recorded with GPS units in 104 game appearances revealed **position-specific movements** that should have implications for training [Gabbett et al., Physiological Demands of Professional…].

Two controversial analyses of acceleration patterns in **soccer** were presented. While agreeing with the general concept, a colleague (Coutts) questioned whether the technology is currently accurate enough, classifications of games and training drills could be made according to the occurrence of **acceleration phases** [Varley , Accelerations in Football…]. Interestingly, teams are much more likely to win when they show more acceleration phases than the opponent team [Varley, Match Score Influence…].

It is surprising that "despite the strong influence simulation (**taking a dive**) can have on the outcome of **soccer** matches, no studies have attempted to quantify and identify factors that can promote or limit this behavior" [David et al., Fighting Back Against Diving…]. The authors did not state the proportion of dives in the 2803 falls they analyzed, but they found a higher proportion closer to the attacking goal, and such falls were more likely to be "rewarded" by the referee. Only 0.2% of dives were punished with a yellow card. No wonder some people don't bother with soccer.

Not surprisingly, **penalty kicks** were less successful when the goalkeeper moved in the right direction in an analysis of 286 penalties in European **soccer** leagues, but there were no other useful predictors of success [White & O'Donoghue, Factor Affecting Performance…]. A stop-motion lab study of the eye tracking and initial movement of nine experienced goal-

keepers confirmed that deception was a successful strategy for penalty kickers but found no useful relationship with eye-tracking of the goalie [Tay, Investigation of the Effectiveness…].

Ball possession is a predictor of winning in English and Spanish **soccer** leagues, but the opposite obtains in the Italian and some other leagues, and there is no consistent relationship in international games [Collett, The Possession Game…].

Game-winning teams in the **soccer** World Cup in South Africa on average scored 2.1–0.5, took ~25% more shots, had ~30% more of the shots on target, were in possession 4% more of total match time, had practically no red cards compared with their opponents' 0.3, made 18% more successful passes, and made 50% more successful crosses [Casamichana & Castellano, Differences between Winning…]. These were the statistically significant outcomes of the 64 matches, which is not nearly enough for acceptably low error rates (false detection and failed detection of effects) in this kind of observational study. Useful findings, nevertheless.

Tests and Technology

Anthropometric and performance **characteristics** of elite **Australian rules** (AFL) **football** players were also described. Not that surprisingly, the pros are older, taller and heavier than amateurs, and whole body and segmental lean mass had moderate to large correlations with bench-press, bench-pull and jump-squat performance measures [Bilsborough, Anthropometrical and Performance Characteristics…].

Bangsbo and others again sang the praises of the **Yo-yo** intermittent recovery test to assess endurance fitness in **soccer** players [Fitness Testing and Training…]. The Yo-Yo test has limitations in identifying intensities for training prescription, and such tests do not predict running activity in games; see a presentation by MB for more.

In an original-research presentation, Mooney et al. identified a positive association between performance in the **Yo-yo** intermittent recovery test (Level 2) and ball disposals in **Australian football** players [The Relationship between Physical…].

The kind of multivariate analysis that Wilson et al. applied to 17 **skill tasks** in semi-professional and elite **soccer** academy players is probably not appropriate when the sample size was only 110 [Quantifying and Analyzing Skill…]: there are likely to be too many spurious effects. It's also unclear how "overall football ability" was defined.

The differences between **fast and slow** professional **soccer** players are related to differences in mechanical muscle measures (explosive strength, maximal isokinetic torque), but locomotor differences (technique, coordination) are also important [Palazzi, Muscle Mechanical Determinants…]. So it's not just a matter of developing muscle strength and power.

A new method to monitor lower limb muscle **flexibility** was presented. While usual methods rely on players' tolerance to stretch, which can bias the evaluation, this method is based on the application of a standard torque. The method was shown to be reliable and independent of the assessor, so any skilled staff in a **soccer** club or academy can make the measurements [Materne, A Novel Method to Monitor…]

When you are evaluating **performance indicators** derived from match analysis, adjusting for the relative strengths of the teams is a good idea [Cullinane & O'Donoghue, Addressing Opposition Quality in **Rugby League**…]. But using the ranking of the teams at the end of the season is not viable if you want to assess players during the season, and adjustment that allows for non-linear effects with increasing disparity between team strengths may be more appropriate.

What **sample size** (players and matches) will you need to quantify the effects of a treatment on a performance indicator in **team games**? It depends on the between-player differences and game-to-game within-player variability of the indicator. For the example indicator chosen (high-speed running in English Premier League, as coded by Prozone), it's 122/N players in N matches pre and post a crossover, or four times as many in a parallel-groups trial, for 90% power and 5% significance [Gregson et al., Estimating Sample Size…]. Divide the numbers by 4 when using Type 1 and 2 clinical errors of 0.5% and 25% with sample size for magnitude-based inferences.

In a qualitative study of coaches from different **football** codes and levels in six focus groups, there was a wide range in perceptions of the utility of **sport science**: "Developmental rugby league coaches and elite soccer coaches had least use for sport research, whereas novice

rugby league and developmental soccer coaches were enthusiastic and motivated to use it in practical coaching sessions" [Nash & Martindale, The Usefulness of Sports Science…].

It's hilarious and amazing that **the red team wins** more matches (about 1 in 10) even in a video **soccer** game [Ohshimo et al., Uniform Color…]. The study needs more than six presumably Japanese players for the finding to be credible and creditable. What aspects of personality or cognition are responsible?

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Videos of Invited Symposia

Most presentations consist of several video clips. The links below take you only to the first in the series; you will have to find the others in the panel to the right of the video window or from the main page of all the video clips. You may have to click the Load More button at the bottom left of the window.

Symposium 1
Sport Science in the Professional Football Codes
Chair: Drust, Barry

CURRENT APPROACHES TO SPORT SCIENCE SUPPORT IN THE ENGLISH PREMIER LEAGUE
Drust, Barry

THE APPLICATION OF SCIENCE IN THE TALENT DEVELOPMENT SYSTEMS OF A CLUB IN THE ENGLISH PREMIER LEAGUE
Iga, John

CURRENT APPROACHES TO SPORT SCIENCE SUPPORT IN RUGBY UNION
Gill, Nicholas

LOAD AND FATIGUE MONITORING IN THE AUSTRALIAN FOOTBALL LEAGUE: A PRACTICAL EXAMPLE
Cormack, Stuart

Symposium 2
Psychology Applied to Football Games
Chair: Hodge, Ken

PSYCHOLOGY OF SUCCESS IN FOOTBALL: CASE EXAMPLES FROM RUGBY UNION
Hodge, Ken

PERFECTIONISM IN FOOTBALL
Araki, Kaori

PERFORMING UNDER PRESSURE IN ELITE FOOTBALL
Jordet, Geir

Symposium 3
Biomechanical Perspective of Artificial Turfs in Football
Chair: Nunome, Hiroyuki

SHOCK ABSORBENCY OF LONG PILE ARTIFICIAL TURF
Nunome, Hiroyuki

BOOT-PITCH INTERACTION DURING A RAPID TURNING MANOEUVRE IN FOOTBALL
Lake, Mark

INJURY OCCURRENCE AND FOOTWEAR PERFORMANCE ON ARTIFICIAL SOCCER TURF
Sterzing, Thorsten

Symposium 4
Women in Football
Chair: Krustrup, Peter

PHYSIOLOGY OF WOMEN'S FOOTBALL: MATCH PERFORMANCE, FATIGUE, TRAINING, TESTING
Krustrup, Peter

PERSPECTIVE OF COACHING FOOTBALL IN WOMEN: JAPAN WOMEN'S CHALLENGE
Sasaki, Norio

OLYMPIC WOMEN'S RUGBY 7s : THE NEW RUGBY ATHLETE
McCallum, Kelly

Symposium 5
Biomechanics and Skill Acquisition in Football Codes
Chair: Williams, Mark

BIOMECHANICS OF PUNT STYLE KICKS IN FOOTBALL CODES
Ball, Kevin

KICKING DYNAMICS IN YOUTH, HIGH PERFORMANCE AND NOVICE PLAYERS
Nunome, Hiroyuki

PRACTICE, INSTRUCTION, AND SKILL ACQUISITION IN FOOTBALL
Williams, Mark

IMPROVEMENT OF KICKING ACCURACY BY SOCCER SHOE DESIGN
Hennig, Ewald

Symposium 6
Analyses and Syntheses in Football
Chair: Tateno, Masami

FOOTBALL AS METAPHYSICS: FROM A PHILOSOPHICAL AND PHYSIOLOGICAL POINT OF VIEW
Tateno, Masami

CONCEPTS AND CONSIDERATIONS IN THE DEVELOPMENT AND IMPLEMENTATION OF A GAME PLAN FOR AMERICAN FOOTBALL
Marshall, Greg

DECISIVE PERTURBATION MECHANISM IN RUGBY UNION

Sasaki, Koh

PREPARATIONS BEFORE GAMES AND ADJUSTMENT FOR EACH PLAY IN AMERICAN FOOTBALL
Itai, Masato

Symposium 7
Match Analysis in Football
Chair: Norton, Kevin

TACTICAL MATCH ANALYSIS IN SOCCER: NEW PERSPECTIVES?
Lemmink, Koen & Frencken, Wouter

MATCH ANALYSIS IN AFL, SOCCER AND RUGBY UNION: PATTERNS, TRENDS AND SIMILARITIES
Norton, Kevin

A NOVEL USE OF GPS FOR PLAYERS' MOVEMENT ANALYSIS IN RUGBY UNION
Iwabuchi, Kensuke

Symposium 8
Scientific Testing and Training in Football
Chair: Bangsbo, Jens

FITNESS TESTING AND TRAINING OF THE TOP-CLASS FOOTBALL PLAYER
Bangsbo, Jens

SPORT SCIENCE SERVICES TO YOUNG FOOTBALL PLAYERS AND COACHES
Peltola, Esa

KINANTHROPOMETRY, BODY COMPOSITION AND FITNESS PROFILES OF JAPANESE SOCCER PLAYERS FROM YOUTH TO PROFESSIONAL: AN APPROACH WITH ADVANCED EQUIPMENTS
Hoshikawa, Yoshihiro

TRAINING FACTORS AFFECTING RECOVERY BETWEEN FOOTBALL MATCHES
Coutts, Aaron

Symposium 9
Talent Identification and Development in Football
Chair: Dawson, Brian

DRAFT CAMPS AND COMBINES: RELATIONSHIP TO CAREER SUCCESS?
Dawson, Brian

PRACTICAL ASPECTS OF HIGH INTENSITY TRAINING FOR TALENT DEVELOPMENT IN A PROFESSIONAL FOOTBALL CLUB SETTING
Mujika, Inigo

THE POSSIBILITY OF TALENT IDENTIFICATION IN THE FOOTBALLS AND TALENT TRANSFER FROM THE FOOTBALLS
Yamashita, Shuhei

TRAINING AND PERFORMANCE MANAGEMENT IN THE TOP
Dijk, Jos van

Symposium 10
Sociology and Economics in Football
Chair: Takahashi, Yoshio

SPORT AND TOURISM IN JAPAN
Takahashi, Yoshio

DESCRIPTIVE SOCIETAL-VALUE STRUCTURE AND MAPPING APPROACH ON FOOTBALL; SOCCER & RUGBY UNION
Sasaki, Koh

Symposium 11
Coaching Issue and Practice in Football
Chair: O'Connor, Donna

COACHING PRACTICE: TURNING THE CAMERA ON YOURSELF
O'Connor, Donna

WHEN TO THINK AND WHEN TO BLINK
Gabbett, Tim

EVOLUTION OF RULE CHANGES AND COACHING TACTICS IN AFL: IMPACT ON GAME SPEED, STRUCTURE AND INJURY PATTERNS
Norton, Kevin

LONG TERM PLAYERS DEVELOPMENT IN RUGBY UNION
Nakatake, Ryuji

Symposium 12
Aerodynamics of Soccer Ball
Chair: Nunome, Hiroyuki

THE AERODYNAMIC PERFORMANCE OF FOOTBALLS: EXPERIMENTAL AND FLIGHT SIMULATION STUDIES USING PROTOTYPES AND INTERNATIONAL TOURNAMENT BALLS
[Passmore, Martin] Seo, Kazuya

AERODYNAMIC CHARACTERISTICS OF A NEW SOCCER BALL
Asai, Takeshi

HOW TO PRODUCE NON-SPINNING “BUTTERFLY BALL
Shinkai, Hironari