Research on Athletes at the 20th Annual Meeting of the European College of Sport Science

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Sportscience 19, 43-54, 2015 (sportsci.org/2015/ECSSsport.htm)

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A fall in attendance was offset by an increase in the number of presentations of interest to sport scientists at the 20th annual meeting of ECSS in Malmö, Sweden. Accessing Videos, PDFs and Abstracts: links to the downloads. Best of the Best: eight studies of injury, monitoring and training. Acute Effects: bright light; warm-ups; mental fatigue; negative visual stimulation; precooling; dehydration; compression garment; sleep; recovery cooling. Injury: motion-control shoes; ACL-injury prevention programs; proprioception training; screening tests for football; ankle sprains in netball; tackle injuries and concussion in rugby; tennis; field hockey; wrestlers; postural orientation; PRP and prolotherapy. Nutrition: energy intake; curcumin; fenugreek; beta-alanine; carbohydrates; nitrate and beetroot; GSSI symposium; branched-chain amino acids; whey protein; caffeine. Performance Analysis: tennis; rowing; handball; cricket; speed skating; lacrosse; recurve archery. Talent Identification and Development: skill, selection, maturation and genes in soccer; psychometric predictors in racquet sports; participation base and clubs in handball; sports clubs; floorball dropouts; issues with talented children; careers after sport; services of higher education institutions; genes in swimming and endurance; expertise of sport psychologists. Tests, Technology and Monitoring: cortisol in hair; heart-rate variability and recovery; anti-doping; player areas; accelerometers for figure skating and running; electronic scoring in taekwondo; mindfulness; eye-tracking; real-time GPS; Prozone tracing system; tennis skill test; cadence in kayakers; game insight in football; training distribution profile; cell-free DNA; training stress; Velotron and Wahoo ergometers; magnitude-based inference. Training: visual for football; perceptual and block-periodized for handball; minimalist-shoe for rear-foot runners; altitude and hypoxia symposium and various studies; experts' programs for top rowers, cross-country skiers and a marathon runner; repeated sprint for football; various strength and resistance studies; hydrodynamic for swimmers; minimalist-shoe for agility in football; contextual vs differential in basketball; muscle stimulation plus endurance; load-guided in runners; periodization of top cyclists; coaching in dressage; beta-agonists plus resistance. KEYWORDS: competition, elite athletes, ergogenic aids, nutrition, performance, talent identification, tests, training.

Malmö in the south of Sweden made an interesting venue for this year's meeting of the European College of Sports Science, June 24-27. The city is famous for the Øresund Bridge linking Sweden to Denmark and for the iconic Turning Torso apartment building. I particularly enjoyed the spacious park close to the conference center and the wide expanse of grassland adjoining the Øresund Strait.

The 20th birthday meeting was well planned and fronted by Susanna Hedenborg and Aage Radmann. Thanks heaps, guys, for keeping us entertained at the opening and closing ceremonies, and thanks to your team of volunteers. Thanks also to the various ECSS committees who had to make so many difficult decisions about the program. So, ECSS is a teenager no more. Let's hope it loses none of its youthful

exuberance in the years to come.

Check out the statistics and logistics in the official debrief, and view images of people and places at the conference flickr page. See also who won the young-investigator awards (summary PDF and links to individuals) and the GSSI nutrition and Aspetar football awards. The total number of abstracts (1587) was down by several hundred since last year and well down on the record number (2452) at Barcelona in 2013. This decline must be a major concern for ECSS. However, compared with the "best-ever" meeting last year, I have found and reported on about twice as many abstracts relevant to sport scientists, and I found eight to include as the best of the best. ECSS therefore continues to be by far the best of the best conferences for those of us with an interest in competitive athletes. Please put July 6-9 into your calendar right now for the Vienna meeting next year, and let's break the record for attendance. And to the organizers of the Vienna meeting: youthful exuberance, please!

To keep the focus of this report on competitive athletes, I have been quite ruthless in selecting presentations. I skipped most abstracts on "healthy subjects" or other non-athletes, unless the phenomenon was novel. I gave up on abstracts that were too dense with abbreviations and acronyms or were otherwise too difficult to understand. I didn't bother with single-measurement comparisons of different groups with only ~10 in each group or with "athletes I have tested" (descriptive or correlational studies of a squad or team with no useful outcome). Even so, writing this report took 63 hours of doing nothing else, so I hope you will understand and forgive me for not reviewing the following topics: athletes with disabilities; the relative-age effect; mechanisms of fatigue; any physiology, biochemistry or "omics" of exercise that did not involve a measure of performance relevant to athletes; orthopedics; and most questionnaire-based injury-prevalence studies. If you have an interest in these topics, do a keyword search of the abstracts (see below). As per last year, a separate review of exercise science at the conference will also be available. Sadly, none of the four plenaries was relevant to sport scientists, but they will feature in the other report.

Accessing Videos, PDFs and Abstracts

The Malmö conference site has program pages for each tier of presentation or a PDF of the full program. The full book of abstracts is available at this link. Videos of plenaries and some invited symposia can be accessed via the ECSS.tv page via the login page for ECSS members only. Members can also access all abstracts, mini-oral slides and e-posters via the Malmö search form or (eventually) via the E***D***SS database. To find the presentations I have reviewed, copy the presenter's name and initial or the session code shown in brackets […] into the search form at the ECSS site or into the advanced search form in the Adobe Acrobat PDF reader. The wide single-column format of the abstract PDFs makes them hard to read. I have suggested previously that the two-column format ACSM uses would be preferable. I will keep complaining.

See last year's report for an explanation of the structure of the ECSS conference. The oral podium presentations and most of the invited symposia have no downloadable content other than their abstracts, while the 379 e-posters and the slides for all 330 mini-orals are available as PDFs. I have complained about this imbalance in the past, but maybe it's a good thing that the e-posters and mini-orals have something special, as a consolation for those who would prefer to present a full oral. And if slides of all the presentations were available online, would fewer people attend the conference? Possibly.

Best of the Best

Here's my pick: motion-control shoes to reduce injury in runners with pronated feet; a program to reduce ACL injuries in junior alpine skiers; cortisol in hair for a measure of chronic stress; visual training for junior footballers; perceptual training for handball goalkeepers; block periodization for handballers; minimalist-shoe training for rear-foot runners; and high-intensity interval training in the heat (but not combined with live-high train-low) for runners. Each of these is preceded by Best!, and if it was a mini-oral to e-poster, I have provided a direct link to the PDF of the presentation.

Acute Effects

The force of a maximal voluntary isometric leg contraction showed the expected circadian rhythm by increasing by ~15% between morning and evening tests of 10 **active males**, but **bright light** for an hour the night before and/or for half an hour in the morning were apparently

equally effective in raising the morning force up to the evening value [Edwards, B]. Morning rectal temperature was unaffected. I fear a placebo effect. Let's see some studies of real athletic performance.

You can lose your **warm up** when you wait typically 15-20 min in the marshalling area. Hence this study: a heated garment plus a "5-min dryland exercise routine" (presumably aimed at generating heat, or did it also induce post-activation potentiation?) produced a clear marginally small 0.3% improvement in 100-m time compared with usual tracksuit and resting in a crossover with 39 elite **swimmers** [McGowan, C]. The effect was much greater when it was reported at last year's swimming conference with fewer age-group swimmers. Another placebo effect?

Conclusion of a literature review: "The use of **warm-up** activities with a length over 10 min, incorporating dynamic stretching and equipment to improve post-activation potentiation and neuromuscular demands (?)… improves performance and reduces injuries" in **team sports** [Peña, J]. The relevant references are shown in the abstract.

The prize for the most egregious use of p values goes to this comparison of effects of eccentric vs concentric **warm-up** on 5-km time-trial performance in eight amateur **cyclists**. The eccentric warm-up "elicited lower cardio-circulatory, metabolic and perceptual strains than concentric without compromising subsequent time-trial performance" [Bosio, A]. The observed effect was actually 1.1% impairment, and when I included it with the p value (0.112) and my estimate of the smallest important effect on time-trial time (0.3%) into the appropriate spreadsheet at this site, I got an 88% risk of harm for the true effect. But that's OK, go ahead and use eccentric warm-up, safe in the knowledge that it wasn't significantly different.

There was a systematic review of the effect of **mental fatigue** on **physical performance**, according to which aerobic performance decreased, but anaerobic performance seemed unaffected [Van Cutsem, J]. In one original-research study of this phenomenon, "mental exertion does not affect elite **cyclists**", because in the crossover study of nine elite cyclists the p value for the effect was 1.00 [Martin, K]. Could you make that conclusion if you had two cyclists in the study? No, and you can't with nine either. Unfortunately, to use statistical non-significance to reach this conclusion, you would need 176 subjects in a crossover. In another study, mental fatigue impaired **soccer**-specific skills performance [Smith, M], but we all agreed that team-sport players are unlikely to do anything like the Stroop color-word test before going out on the field.

What we want to see next is attempts to *enhance* performance by doing something that achieves the opposite of mental fatigue: arousal with motivational videos, positive self-talk, whatever. A study heading in this direction was supposed to have been presented as a mini-oral, but I was at another session and there are no slides to download, so the presenter couldn't have turned up. Anyway, **negative visual stimulation** (whatever that is) enhanced handgrip force, and the effect was modified by personality in 58 elite **athletes** in unspecified sports. [Üngür, G]

Self-paced 5-km **running** performance at 33°C was improved by a similar amount (~3%) with **precooling** by cold-water immersion or by intermittent facial water spray compared with control in this crossover study of nine trained male runners [Stevens, C].

"Preliminary results suggest no impact of mild to moderate **dehydration** on reliable and sensitive measures of **motor racing** performance." [Mollica, J]

Wearing an upper-body **compression garment** significantly *impaired* performance in a run to exhaustion following a pre-load in a crossover with 10 recreational male **runners**. Changes in most physiological markers were consistent with the impairment [Leoz-Abaurrea, I].

In this **sleep** study, in which 23 **Australian football** players were monitored for 14-18 nights during the competitive season, there was "empirical support to avoid caffeine and the use of technology immediately prior to going to bed" [Coutts, A].

The main finding in a meta-analysis of post-exercise **cooling** strategies for **recovery** (apparently mainly in studies of delayed-onset muscle soreness in **non-athletes**) was that cooling and especially cold-water immersion reduced soreness, but there was no evidence that cooling affected objective measures of recovery [Hohenauer, E].

Injury

Best! In this six-month double-blind randomized control trial of 372 recreational **runners**, **motion-control shoes** produced a very large reduction in risk of injury (hazard ratio 0.28) in runners with pronated feet, but apparently little effect in runners with normal feet [Malisoux, L]. This outcome is bound to be disputed, perhaps because "training and injury data were collected during 6 months on an internet based platform." I guess we need evidence based on physician-diagnosed injuries.

Best! Using historical injury incidence as a control, the effectiveness of a comprehensive injury prevention program focusing especially on **ACL injuries** was assessed on the competitive **alpine skiers** at a Swedish school. "RESULTS: to be presented at the conference"! I didn't attend that session, but in the mini-oral slides at the ECSS site they reported a 45% reduction of the ACL injury incidence rate and this link to a professional-quality video explaining the program. [Westin, M; View]

Proprioception training added after regular **basketball** training sessions resulted in better balance ability (and therefore potentially less risk of injury when players are fatigued in training and games) than when added before or when not added at all in an 8-wk controlled trial of 11+11+11 female basketball players. [Pojskic, H].

Video feedback on jump-landing strategies by means of "an expert overlay movement of the athlete" improved landing technique in a controlled trial of 20+20 male **team-sport athletes**, so may reduce risk of **ACL injuries**. Strangely, it didn't work in females, who may need "additional verbal feedback". [Dallinga, J]

Groin squeeze was the best of eight musculoskeletal screening tests for predicting **injuries** in 71 players of one **Australian football** club over four seasons. I'm a bit skeptical about identifying different best tests for different periods of the season with so little data. [Quain, D]

With only 11 **ankle sprains** in this one-season prospective study of only 96 **netball** players, the identified risk factors (posterior-medial reach distance and two measures of balance) need more evidence from a lot more injuries. [Attenborough, A]

A case-control study of 49 **tackle injury** events (controls: 249 non-injury tackles) in **rugby union** was analyzed with the nature of the tackle rather than the risk of injury as the outcome. Nevertheless, there appeared to be moderate to large reductions in injury risk for "front-on and side/behind score for ball-carrier proficiency" and for "fending away from contact". For tacklers, overall front-on and side/behind proficiency was associated with moderate to large reductions in injury. [Burger, N]

The same group did a similar analysis of the effects of contact technique on risk of **concussion** in **rugby union**, but it had the sample-size problem of the above netball study–only 10 concussions. [Hendricks, S]

Similarly, findings from retrospective questionnaires about **injuries** in 107 German (?) nationally ranked junior **tennis** players and 107 **field hockey** players have limited utility. [Fett, J]

Traditional **wrestlers** experienced three **injuries** per 1000 combats in this prospective cohort study of 227 wrestlers over 9 y. Various risk factors were identified, but I can't see how they could lead to strategies for injury prevention. [Casals, M]

Visual ratings of "**postural orientation**" had reasonable reliability in this systematic review thereof, although it's worrying that the most commonly used measure, knee medial to foot position, detected only half the **athletes** at high risk (for injury?) in one study. [Älmqvist, J]

A case-control study of 20+20 pathological and normal **patellar tendons** has identified hyper-methylation of a regulator region of a gene known to be already involved in tendinopathy [Raleigh, S]. OK, now what?

Interviews about novel treatments with 18 physios and doctors working in the English premier **football** league revealed that **actovegin** (an extract of calf blood, for performance presumably), **platelet-rich-plasma** therapy (PRP), and **prolotherapy** were the most popular novel treatments (for injuries), although "evidentiary bases for them are not supported strongly by randomized control trials" [McNamee, M].

Nutrition

"This is the first prospective study [of 14 competitive female **runners**] to show that failure to increase **energy intake** and maintain energy balance during a period of heavy training significantly increases the risk of developing non-functional over-reaching [i.e., over-

training] and menstrual disturbances" [Schaal, K]. So increase your energy intake during periods of intensified training.

"**Curcumin** supplementation likely attenuates delayed onset muscle soreness… Associated with the pain reduction was a 15% increase [reduction in the decline] in single-leg jump performance" in this cross-over study of 17 **men** [Rowlands, D]. As with any recovery strategy, you need to know if it impairs adaptation long-term.

The abstract is confusing, but it looks like post-exercise supplementation with powdered seeds of **fenugreek** (which contains a compound with an action like insulin) resulted in faster glycogen re-synthesis in this well designed study of 15+15 competitive male **kayakers**. [Ataei, L]

Beta-alanine vs placebo supplementation followed by maintenance dosage and 6 wk of high-intensity interval training did not lead to any obvious difference in improvement in endurance cycling performance in double-blind randomized controlled trial with 7+6 **active men**. The presenter speculated that an "uncapped" training protocol might have shown a difference, because the beta-alanine group could have done the intervals at higher intensity, owing to the increase in intramuscular buffering via the increase in carnosine [Chung, W]. Not surprisingly, it worked on 4000-m time-trial time in highly trained **cyclists** [Bellinger, P].

Does ingestion of multiple **carbohydrates** (glucose + fructose or glucose + sucrose) post-exercise lead to faster muscle glycogen repletion than glucose alone? An important question, and this was an heroic study to address it: the 14 male **cyclists** had nine biopsies altogether, and the young investigator got third prize for the mini-oral. Unfortunately a non-significant difference can't be interpreted as no difference in an underpowered study, which this was. I calculated that there was a small-moderate greater amount of glycogen re-synthesis (~5-10% more) with the multiple carbohydrates. So use multiple carbohydrates when there is an urgent need to recover in a tournament or heats/finals setting. [Trommelen, J]

Six male and 4 female **swimmers** achieved almost exactly the same 10-km swim times (1:54:26 vs 1:54:27 h:min:s) when they supplemented with either **carbohydrate** or water (blind?) [Baldassarre, R]. You'd expect carbohydrate to enhance performance for such exercise, but the confidence interval for the difference prevents us from having to make a paradigm shift.

I can believe that a **carbohydrate** mouth rinse "does not improve performance" in high intensity cross-country sprint **skiing**, but you'd need vastly more than seven skiers to make such a claim on the basis of the observed tiny difference. [Kårström, A]

Non-significance as usual became no difference in a crossover study of the effects on endurance performance of 6-d, 1-d and placebo supplementation with sodium **nitrate** in 17 reasonably well-trained **cyclists** (VO2max 65 ml/min/kg). But the 6-d treatment produced 1.9% and 1.3% enhancements in power output compared with the 1-d and placebo treatments.

P values only were given, but it looks like **beetroot juice** can produce a reduction in the oxygen cost of high-intensity exercise (80% of VO2max) compared with nitrate or placebo in a multiple crossover with 10 **trained men** [Flueck, J]. This finding suggests beetroot juice could be more effective than nitrate for endurance, but there was little evidence for such an effect in a recent meta-analysis (Braakhuis and Hopkins, 2015).

In a **sports nutrition symposium** sponsored by GSSI (Gatorade) on "advances in the application of science in the **sporting** environment", the three speakers demonstrated that there haven't been any such advances lately. [IS-PM01]

You've heard of delayed-onset muscle soreness (DOMS), but what about IOMS? "Immediate-onset muscle soreness is frequently observed in exercise involving running, particularly in long distance running, with onset sometimes even occurring during exercise." Supplementation with **branched-chain amino acids** reduces the severity of DOMS and markers of muscle damage, and in this study it did the same for IOMS in 36 **marathon runners** who were randomized to BCAAs or placebo supplementation three times a day before and after the event [Ishikura, K]. So it was an underpowered between-subjects design, and therefore the unstated effects were probably small-moderate. I'm not totally convinced…

Supplementing with the right kind of protein improves strength training, but what about en-

durance? Apparently not: 6 wk of **whey protein** plus **carbohydrate** before and after training sessions resulted in a similar improvement in 6-k run time (~1.5%) compared with isocaloric carbohydrate in a randomized controlled trial of 24 well-trained **runners** [Hansen, M].

Caffeine ingestion improved strength, perception and mood, but it did not improve cognition, and it impaired sleep in a crossover study of 10 **intermittent games** players [Ali, A].

Performance Analysis

Here's the conclusion from an analysis of male U-14 state **junior tennis** championships: "Coaches of elite players should focus on strategies to optimize **court position** following the serve, and **service/return percentage** within short rallies to optimize success rate in junior tennis." [Klaus, A]. Download the mini-oral for details.

The author of this abstract has developed a model to optimize the **pacing profile** in a 2000-m **rowing** race, and it differs substantially from what rowers do. Assuming time trials show that the theoretical really is substantially better than the real, the problem will be training rowers to achieve their optimum consistently [Rachnavy, P].

The **goalkeeper** in women's **handball** has time to react to the trajectory of a thrown ball to intercept it, but men throw the ball 25% faster, and the goalkeeper has to read the thrower's movements to have any hope of intercepting the ball [Estriga, L].

Interchange strategies using shorter periods of work and rest result in less fatigue and more high-intensity movements throughout a simulated **handball** match [Moss, S].

A neural-net analysis of player positions in 12 games of men's **handball** identified various **offensive and defensive actions** and their chances of success (goal scoring?) [Alsaied, S]. Unfortunately neither the abstract nor the poster are any more informative.

Playing positions in women's elite **handball** differ in the amount of **high-intensity movements** [Luteberget, L].

Modifying the **playing rules** for training in **cricket** was better than reducing the field size or number of fielders "to maintain or improve the physical capacity of players, without compromising the amount of time spent in game-specific skill sessions" [Vickery, W].

The **race-to-race variability** in performance times of **speed skaters** (~1%) is a little less than that of elite track cyclists, another sport performed against air resistance. Smallest important effects on time are therefore ~0.3%. Converted to units of mean power (by multiplying by 2-3), the variability is about twice that of elite track runners, presumably reflecting variability in technique between races [Noordhof, D].

This study appears to be the first to describe **performance indicators** of Division-I men's **lacrosse**. "Longer single possession time and higher numbers of shots, passes and runs are closely related to success" [Hauer, R].

Spatial analysis of **hit distribution** in **recurve archery** can be more useful than the usual score. [Ertan, H]

Talent Identification and Development

If you're a youth elite **soccer** player, you've got more chance of future success if your coach thinks more of your **skill** than you do. This abstract appears to be a slightly different version of one presented at the football conference a month ago. [Hofseth, E]

The relationships between being **selected** for the male U-15 Norwegian national **soccer** team, being selected for the male A-national team, and subsequent career length (defined as the number of appearances in the A-national team) was investigated in 563 players over ~20 y. There was a weak relationship of selection to the U-15 national team with later selection to the A-national team, as well as with career length, while the association between selection to the U-21 national team and future A-national team appearances was stronger. [Welde, B] It appears the early selection process is flawed, or maybe there's nothing you can do about it.

In an unsurprising one-season longitudinal study of 50 young **soccer** players (age 12 y), **maturation** and **body size** appeared to be the reasons for being selected to play in the Spanish elite soccer academy, whereas **improvements in performance** during the season appeared to be the main reason to progress to a higher level [Bidaurrazaga-Letona, I].

In a systematic review of **psychometric predictors** of talent in young **racquet sport** players, "there is moderate evidence that mental and goal-management skills predict future performance", but "lack of longitudinal studies preclude verification of the instruments' capacity to forecast future performance." [Faber, I]

The number of national-level youth players in a sport coming from a given region varies from region to region. So what's the more important cause of that variation: the number of kids in the region or the number of kids playing that sport in that region? Surely it's the **number of kids playing** the sport, but I can't see how the analysis presented here for **handball** in Denmark shows that. [Rossing, N] See an item in the report on the swimming conference last year for a clear result: more kids participating means better performance.

A case study of two exceptionally successful **handball** clubs in Scandinavia should provide useful information for talent identification and development in sports generally, but the Danish English and jargon of the "social learning perspective" make the abstract a difficult read. In plain language, talented young players had **opportunities to interact** with the senior elite players, who had influential mentoring roles facilitated by the coaches. [Storm, L]

In an ongoing study of 585 Swedish children born in 1991, a questionnaire revealed that only one-third of those who joined a **sports club** stayed on into their late teens. Based on the responses, "the conclusion is that sports clubs should try to organize activities emphasizing development with numerous **opportunities and challenges for motor and social learning** and less focus on competitions" if they want more children participating longer. [Thedin Jakobsson, B]

Interviews with 12 girls (age 13-18 y) who dropped out of Swedish **floorball** revealed "absence of representatives from the sport clubs in the girls' disengagement process… One message to the sport organizations is therefore to gather knowledge of their members' thoughts and feelings about their sport participation and to be **proactive in handling changes, group cohesion and coach education**" [Eliasson, I].

A good summary of the **moral**, **ethical and social issues** surrounding the development of talented children in elite **sports** is provided in this abstract [Pilz-Burstein, R].

What do **sports** think about services provided by **higher educational institutions**? Unfortunately the presenter didn't show up to tell us. According to the abstract, they thought there was moderate benefit (mean of 4.1 on a 1-5 scale) for performance enhancement, but only half were interested in the research and innovation [Thompson, K].

Administrators concerned with facilitating **athletes' careers after sport** should read this abstract about the Italian experience. [Guidotti, F]

"We have observed an increased frequency of the ACE-DD **gene** polymorphism in higher levels of competitive sports with anaerobic predominance [here, **soccer**]" [Coelho, D].

It's not clear how they did it, and some of the numbers don't make sense, but anyway, a Russian contingent thinks they've identified **genes** associated with **swimming** performance in 250 female and male swimmers age 10-19 y, and it looks they'll take them into account in talent selection and development. [Yevdaliuk, S]

A comparison of prevalence of variants of eight **genes** in 272 elite **endurance athletes** and 528 controls revealed nothing conclusive [Lockey, S].

The abstract giving an overview of a symposium on the development of **expertise** and competencies of applied **sport psychologists** in Europe comes after the abstracts of the three main presenters. [Johnson, U]

Tests, Technology and Monitoring

Best! This mini-oral was one of the most interesting presentations of the conference. **Cortisol** measured in the **hair** that grew during a one-month attitude camp with seven female distance runners had a strong negative correlation (r=0.76) with the change in hemoglobin mass. There was a similar negative correlation with change in VO2max, but only five **runners** had a change for this measure [Bamba, A; View]. This finding fits with the notion that stress attenuates any benefit of altitude training. Cortisol in hair evidently represents an integrated measure of stress, but I can't see it as a particularly practical measure, especially for tracking stress over a period of days to a week or two. And the sample size was too small to get too excited just yet.

A symposium on **heart-rate variability** (HRV) sponsored by Polar (makers of heart-rate monitors and software) did not have abstracts or video recordings. The first speaker, Tracy Baynard, presented encouraging evidence that HRV has diagnostic and prognostic value for some diseases (lower variability is worse), but the other two speakers (Mikko Tulppo and Martin Buchheit) left me skeptical about its utility with athletes. Martin's talk was based on

a Frontiers article he published last year (Buchheit, 2014); he changed the title from "do all roads lead to Rome?" to "tools or toys?", and I don't think he answered the question in the 15 min that he was left to deliver a 30-min talk. In a follow-up email he wrote that "HRV can be useful if you understand the very wide limitations that I highlighted." Nevertheless I heard no clear advice here or elsewhere in the conference on how you should use acute changes in HRV to adjust training load or how you should interpret chronic changes as an indicator of performance. Judge for yourself from the following presentations…

Heart-rate variability went down on average in 7 female and 8 male resistance-trained **athletes** in the days following 6 d of intense resistance training [Schneider, C]. But when 15 **runners** and **triathletes** overloaded for 2 wk to the point of impaired performance, then tapered for 10 d and recovered, heart-rate variability went up (unexpectedly) in the overload and up (as expected) in the taper. "Thus, interpretation of HRV to diagnose such training adaptations is difficult in isolation, indicating the importance of measures of training tolerance [from performance tests and perceived fatigue] to contextualize changes in HRV and allow for effective monitoring in the field" [Bellenger, C]. Well, that all sounds very grand, but you could also argue that measuring "training tolerance" is all you need to do.

Changes in **heart-rate variability** parameters did not reflect variations in daily or weekly training load in this study of six elite **swimmers** in three annual training camps [Ganzevles, S]. In question time, a supporter of heart-rate variability (Paul Laursen) suggested that the measurement protocol might have been at fault.

Faster **recovery of heart rate** following exercise is supposed to be sign of positive adaptation to training, but it was also a sign of exhaustion in this study of 10 **runners**, who had faster heart-rate recovery with increased perceived effort after the 87-km Comrades ultramarathon. Functionally over-reached athletes also have faster heart-rate recovery [Lamberts, R]. The presenter mentioned that similar paradoxical responses in heart-rate variability were found in another over-reaching study, which hopefully will be presented next year in Vienna. "The current study emphasizes that changes in heart-rate recovery [and heart-rate variability] should always be interpreted in the light of changes in other parameters, such as perception of effort."

For those interested in progress in **anti-doping**, there was a symposium with contributions on the hematological, steroidal and endocrine modules of the athlete's biological passport. [Morkeberg, J, Schulze, J, Dehnes, Y]

If you're interested in tracking **areas** occupied by groups of players in **team sports**, see how this group achieved it. [Santos, R]

Timing of "biomechanically relevant events" in **figure skating** was achieved with acceptable precision with an **accelerometer** on each skate [Schäfer, K]. It looks like it also works for stride length with **running**. [Brahms, C]

The current **electronic scoring** system built into the chest protector in **taekwondo** has hopelessly low validity. [OSullivan, D]

No data are shown, and "applied implications are discussed" (sigh…), but two dimensions of **mindfulness** might be worth measuring, if they turn out to have strong enough relationships with some **soccer** skills at the elite level. [Meland, A]

Youth **basketball** players wore **eye-tracking glasses** on the court for analysis of gaze behavior when they were the ball carrier in 3 vs 3 pick-and-roll basketball play. "Further analyses of gaze behaviour may give insight into why some players make better decisions than others." [van Maarseveen, M]

"These data highlight marked differences in the measurement of simulated **team sport** activity between **real-time** and post-session download **GPS** analyses" with three athletes [Minett, G]. The real-time transmissions of distances and speeds are untrustworthy with these units (GPSports, model SPI HPU).

The Prozone **motion-capture tracing system** does not appear to stack up against the criterion timing lights for detecting high-velocity movements in **soccer** [Enright, K].

My colleagues have apparently developed a new **skill adaptability test** for talent identification (and development?) in **tennis**. "Validity and reliability returned strong correlations" [Potter, A]. Where's the data? I'll have to have words with them.

In this study of the effect of **cadence** on **oxygen consumption** in elite **flatwater kayakers**, the surprising finding was that the kayakers were more economical at their self-chosen ca-

dence than when they had to maintain that cadence [Pedersen, A]. In other words, having to concentrate on maintaining a given cadence caused them to become less efficient with their stroke technique. So, to identify an athlete's optimum cadence in this and other sports, it's important to let the athlete choose different cadences without external timing prompts.

Using the combined ratings of eight coaches as the criterion, this researcher devised and validated a **video occlusion task** to assess game insight in young **football** players [Savelsbergh, G].

"This study introduces the **training distribution profile** as a method for sports scientists to present and analyze large training datasets." It was developed from a year of GPS monitoring and performance testing of 14 highly trained male endurance **runners**. Apparently time spent training at 5.3-5.7 m/s was associated with significant improvements in running performance, but it's not clear how strong and therefore how useful the relationship was. [Passfield, L]

Circulating **cell-free DNA** increased with increasing intensity and duration of exercise in 13 **subjects**, so it could be a useful measure of exercise load. [Haller, N]. An inexpensive test kit would have to be devised.

If you want to monitor **training stress** with a questionnaire, the multi-component training distress scale (MTDS) had stronger relationship with performance than the longer recovery stress questionnaire (REST-Q) in this 8-wk study of 21 national-level **swimmers** [Main, L]. Whether either questionnaire usefully tracked *changes* in performance is not clear.

The **power-speed relationship** for the Velotron **cycle** ergometer is $P=k.S^{2.4}$ [Schoenmakers, P]. This relationship was established ~15 y ago for the Kingcycle ergometer; it reproduces the relationship for flat road cycling, where the 2.4 is due to 3.0 for air resistance with a small contribution of 1.0 for rolling resistance. It follows that a 1% change in speed or time requires a 2.4% change in power.

My reading of the validity data for the **Wahoo Kickr** power trainer **cycle** ergometer vs a dynamic calibration rig (which I assume to have random error of <0.5% and no systematic error), is that the Wahoo introduces a random error of ±2% (the ±limits of agreement divided by 2.78) [Zadow, E]. As such, the error is too high for serious cyclists, unless you can average over a longer period and the error goes away. Also, it doesn't seem to be simulating cycling properly, because the retest error for speed and total time are greater than that for mean power, yet they should be less than half if the device is simulating the speed-power relationship of cycling like the Velotron does.

The "statistical review" of **magnitude-based inference** published in Med Sci Sports Exerc last July and webcast from the Australian Institute of Sport in August was presented without anything new in a mini-oral. In question time I pointed out that an effect with a confidence interval that includes trivial values can't represent a Type-I error when the true effect is trivial, because the confidence interval tells you the true effect could be trivial. It follows that the Type-I error rate is always <5% with a 90% confidence interval, whereas for null-hypothesis testing with 5% significance the Type-I error rate is always >5%. I also pointed out that the sample sizes produced by the spreadsheets at Sportscience are correct, because simulations with those sample sizes produce the error rates they are based on. Welsh contacted me subsequently, and Alan Batterham and I have exchanged messages with him. He just goes on asserting that MBI is not Bayesian, even though Bayesians themselves say it's Bayesian. So when we calculate an 88% chance that the true effect is harmful (see above), he says it's not an 88% chance of harm unless it comes from a "fully Bayesian analysis". But ours is fully Bayesian, with a non-informative prior. His response to the Type-I error argument was that our definition of Type-I error (a trivial true effect is declared non-trivial) is wrong. Sigh…

Training

Best! Video-based **visual training** added to usual training of 18 players in a national **football** academy improved decision time and proportion of successful decisions compared with usual training in 16 players in this randomized controlled trial. "The transfer to a field-based reactive agility test suggests that such training can improve game performance" [Nimmerichter, A].

Best! Video-based **perceptual training** significantly improved anticipatory responses to direct and deceptive ball throws in this randomized controlled trial of 42 **handball** goalkeepers assigned to 7 d of either perceptual video train-

ing, regular video training, or no video training [Alsharji, K; View].

Best! When a first-league women's **handball** team switched from traditional to **block periodization**, the gains in various fitness measures over the season were all substantially greater [Manchado, C; View]. This was hardly a randomized controlled trial, but it shows how you can get believable evidence for the effects of an intervention with a team.

Best! It's not just the lighter weight of **minimalist shoes**; according to the authors of this controlled trial, the shoes will make a rear-foot striker move to the forefoot and thereby recover "elastic energy in the ankle plantarflexors". So, they got 50 rear-foot strike **runners** to train for 6 wk after being randomized either to progressively transition to minimalist shoes or stay with control shoes. Along with various biomechanical differences in the changes, the minimalist group improved 5-km treadmill time by ~4.5%, clearly better than the control group's ~2.5% ("~", because only changes in seconds are stated) [Fuller, J]. From the SDs of the change scores, there's only a hint of individual responses, in this sample anyway.

Best! In this randomized controlled trial with well-trained **endurance runners**, 10 performed **high-intensity intervals in the heat**, 9 did the same but **lived high and trained low** in an altitude house, while 8 did the intervals only at normal temperature. Then they all tapered for 3 wk. A 3-km time trial was performed pre and post the interval training and post the taper. There was little difference in the change between groups in the first post test, but after the taper the heat-only group was 3.3% faster, the heat+altitude group was only 0.6% faster (in spite of an increase in hemoglobin mass of 3.8%), and the control group was only 0.2% faster [McCleave, E; View]. Did lying down in the altitude house have a detraining effect? See the next item. One thing is reasonably clear: it won't hurt to replace altitude camps with heat camps.

I chose not to attend a symposium on **altitude and hypoxic training**, because the abstracts revealed the same contrasting views of two of the presenters as in my report on the altitude conference at the Beijing Sport University a month earlier [Robach, P (Carsten Lundby's colleague); Gore, C]. The third presenter argued for better effects from hypobaric (real altitude) vs normobaric hypoxia [Millet, G]. One of the conference attendees, Nathan Townsend, suggested to me later that this difference might arise from the detraining effect of too much time spent lying down in altitude houses.

Mucosal immunity actually *improved* during a 10-d **live-high train-high altitude camp** with 9 male and 2 female elite **cross-country skiers**. But sleep quality and quantity got worse. "However, these reductions do not appear to be severe and could likely be compensated for by making provision for day-time naps and some modest adjustments in training and meal times to allow athletes more time in bed" [Svendsen, I]. I wonder if a heat camp compromises immunity.

In this randomized controlled trial with 28 well-trained **triathletes**, training low and living high at either real or normobaric **altitude** of 2250 m for 18 d increased hemoglobin mass equally (~4%) and 3-km run time equally (~4%), whereas the changes in the control group were 1.9% and 2.1%. All inferences were done with p values, and no comparisons of changes were significant, so what would you like to conclude? [Hauser, A]

In a randomized controlled trial of 9+9+9 moderately trained **participants**, 5 wk of **sprint interval training** on a cycle ergometer in normoxia, **hypoxia**, or hypoxia plus **nitrate** supplementation produced similar improvements in various measures of performance, but 30-s Wingate mean power showed twice as much improvement in the nitrate group (12%). I think there were too many comparisons for too few subjects in one too many groups to take too much notice of this finding. [De Smet, S]

A symposium on **performance and training** of the top athlete was entertaining, and there is useful material there for anyone involved with training **rowers** (Peter Moller Christensen), **cross-country skiers** (Hans-Christer Holmberg) or **marathon runners** (Andrew Jones). However, there was nothing particularly contentious or innovative. Questions about taking individual differences into account didn't get any clear answers. Only the talk on rowers has an abstract [Christensen, P], but all three talks are available to ECSS members on the ECSS.tv page.

"A low weekly volume of speed-endurance [**repeated-sprint**] training towards the end of

the season improved intermittent exercise capacity (the Yo-Yo Level 1 test) in highly trained **football** players. This part of the season has previously been associated with a decrement in such performance" [Gunnarsson, T; Nyberg, M]

Well-trained female **cyclists** (n=11) improved their 40-min mean power by 6% when they combined **heavy strength training** with usual endurance training, whereas "no changes occurred" in the control endurance-training group (n=8) [Vikmoen, O]. If you are going to use statistical significance, you are obliged to consider the significance of the difference, not the difference of the significance.

A podium session on **strength training** and testing featured several studies aimed at comparing protocols to increase strength in **trained males** [Nicholson, G; Ferreira-Junior, J; Maeo, S] and adolescent elite **judoka** [Pelzer, T].

Preceding traditional **resistance training** with **plyometrics** resulted in moderately faster on-ice sprint performance in an 8-week controlled trial with 8+8 U18 and U20 **ice-hockey** players [Dæhlin, T].

You can't really conclude that **heavy strength training** does not affect performance in junior female **cross-country skiers** when you have only 9+7 skiers in the trial [Losnegard, T]. On the other hand, the effect was big enough to conclude that upper body **sprint intervals** for 8 wk improved upper body strength and aerobic capacity in controlled trial of 8+9 highly trained junior female **cross-country skiers** [Hovstein Kruken, A].

Isokinetic training with a standing rotation exercise for 8 wk tended to improve club-head speed in comparison with control strength training in a (randomized?) controlled trial of 10+10 **golfers** (13 men, 7 women) [Parker, J]. It's hard to read the effect off the graph, and there's not enough information for a magnitude-based inference.

"The study shows how a simple and short program of **plyometric exercises** has a significant influence on the vertical jump height in young female **basketball** players", but the presenter didn't show up. [Benis, R]

It was an uncontrolled study, but there were impressive increases in jab-punch speed of 6-11% in 40 national-level junior **kick boxing**, **savate**, and **boxing** competitors practicing **jab punching** against elastic resistance for 15 min a day, 3 times a week for 6 wk. [Suzovic, D]

Two 1-wk blocks of low-load **blood-flow restricted resistance exercise** during 6-wk of periodized strength training in 9+8 national-level **powerlifters** produced an unclear outcome on isokinetic strength. [Bjørnsen, T]

By spending an extra 20 min in specific training four times a week for three months, eight national-level **swimmers** (age 15 y) were able to improve their **hydrodynamic profile**. But 50-m time improved by only 0.3%, which is borderline worthwhile and maybe would have occurred anyway. [Ciapparelli, C]

Five weeks of change-of-direction speed training in **minimalist** vs usual **shoes** led to bigger improvement in agility in this controlled trial of 9 vs 11 junior **Australian football** players. The gains may be due to changes in intrinsic foot strength [Graham, S].

A study comparing **contextual interference** and **differential** learning in acquisition of a skilled task (**basketball** passing) in novice basketballers seems well informed by theory and might have some practical relevance [Beckmann, H]

Superimposing direct **muscle stimulation** during 14 **endurance training** sessions over 4 wk resulted in *less* gain in VO2max compared with usual training in this controlled trial of 21 male **subjects**, and there was evidence of muscle damage. It was worth trying. [Mathes, S]

They were only recreational **runners**, so briefly, 14 doing conventional best-practice training improved slightly *more* than 10 who combined it with **load-guided training** provided by the latest Polar heart-rate watches [Schumann, M]. Looks like another example of a toy rather than a tool.

Compare the **periodization** of your training load on your power meter with that of some of the best professional **cyclists** in Europe and Australia [Menaspà, P].

"This study sheds light on **communicative strategies** deployed by **dressage** coaches in their work in the riding hall." In the following abstract the same authors report how coaches in dressage riding describe their methods for teaching riders to communicate with their horses. [Lundgren, C; Zetterqvist Blokhuis, M]

If you take **beta-agonists** for control of asthma, it turns out you get an unfair advantage (or is it just re-leveling the playing field for asthmatics?). Twenty-one non-asthmatic competi-

tively **active males** were randomized blind to salmeterol, fomoterol or placebo twice daily for 10 wk of resistance training. Sprint performance increased by a massive ~10% in the two drug groups relative to placebo, and there were similar massive gains in 1-RM leg press. "WADA may consider re-introducing the requirement for therapeutic-use exemption certificates." [Merlini, M]

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Acknowledgements: ECSS and High Performance Sport NZ contributed to my conference expenses. The Norwegian Defence Institute funded my travel to and from Europe.

Published July 2015