

## Inspirational Insights for Athletic Performance at the Annual Meeting of the European College of Sport Science

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This conference in Essen, Germany, was one of the best. [Accessing Abstracts and Videos](#): links to a search engine and downloads. [The Wow Factor](#): seven of the best presentations. [From Lab to Track](#): a pre-conference symposium. [The Science Slam](#): student research as entertainment. [Acute Effects](#): sleep; bright light; morning pre-comp exercise; warm-up; stretching; post-activation potentiation; cooling strategies; stance for goalies; finger-grip for rock climbers; dynamic tape for ankle instability; pacing; fatigue; recovery. [Injury](#): training and nutritional strategies for healing; FIFA 11+ and 11+ Kids; stress management; functional movement screen; acute:chronic training; fascial manipulation; prevention programs; head injuries; genes and hamstrings; landing biomechanics in ACL; serving and training load in tennis; knee pain in runners; anthro and ankles; tackles and cervical; skiers. [Nutrition](#): chronic phytonutrients still unclear; nitrate; caffeine; taurine; tyrosine; creatine; hydrolyzed keratin; quinine; protein. [Performance Analysis and Monitoring](#): coach perception; fitness-fatigue models; Bayes; subjective plus physiological; perceived stress; pacing; tennis serve; endurance in soccer; defensive balance; basketball referees; contact with the hurdles; fat oxidation, lab tests and other correlates of performance. [Talent Identification and Development](#): trainability is genomically unpredictable; deliberate practice for football; league systems; junior tennis; relative-age effect; Fulda Movement Check; German Motor Test; kids football; coach autonomy support; Perth hotspot. [Tests and Technology](#): big data software for team sports; biomechanical modeling of equipment; a short recovery questionnaire; non-invasive muscle typing; judo test; Footbonaut test; Play-Sight SmartCourt system; Fitbit Charge; biological passport; golf swing test; local positioning system; smart phone food intake; Delsys sensor; mini VO2 analyzer. [Training](#): adaptability for tennis; strength, power, endurance for youth; polarized and resistance for swimmers; strength for futsal; variable, balance, plyometric and self-videos for football; block, traditional, and undulating periodization; active, cold-water and inspiratory recovery; altitude. KEYWORDS: competition, elite athletes, ergogenic aids, injury, monitoring, nutrition, performance, talent identification, tests, training.

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If the thought of Germany's industrial heartland prevented you from coming to the Ruhr for the [2017 meeting](#) of the European College of Sport Science, July 5-8, you made a big mistake: the dark satanic mills have given way to a green and pleasant metropolis. There can be absolutely no excuse for missing the [2018 meeting](#) in Dublin, the capital city of the Emerald Isle. Mark its key dates in your calendar now.

The venue for the conference was disappointing: the lecture rooms appeared to be an archi-

tectural afterthought, hidden in the recesses of two widely separated unattractive buildings. But the opening ceremony was spectacular, and the conference itself was one of the best. The conference theme was *individuality, identity, inactivity, and inclusion*. The outgoing ECSS president (Tim Cable—thank you!) and incoming president (Joan Duda—good luck!) added *inspiration* in their addresses, and any omission of *insight* was obviously an oversight. Congratulations and thanks heaps to the conference presidents, Alexander Ferrauti and Petra Platen,

along with their energetic team of volunteers, the ECSS committees, and the ECSS office staff who made it all happen.

Check out the statistics and logistics in the [official debrief](#). See who won the [young-investigator awards](#), the [GSSI nutrition awards](#), the [Aspetar football awards](#), and for the first time this year, the [German Tennis Federation award](#). Once again there's a very extensive and no doubt very expensive [picture gallery](#) (login: ECSS2017) that I gave up on after a few clicks, so once again my plea: can we have an interesting slideshow of highlights next year, or something to better justify all those pics?

It's worth arriving at the conference a day or two early to attend pre-congress events in your area of interest. This year there were [three symposia](#) to choose from: two on the Tuesday, and another plus [multiple workshops](#) on the Wednesday morning. I opted for the symposium at Ruhr University Bochum, one of the three institutions hosting this year's meeting. [See below](#) for a summary of the symposium and of the inaugural [Science Slam](#), which followed it on the Tuesday evening.

### Accessing Abstracts and Videos

As in all my reports, I have focused on performance of competitive athletes, but ECSS is much, much more. To find abstracts in your area of interest, go to the [Essen conference site](#), click on the [congress tool](#) on the right of the page (if it's still available), from where you can link to pages for each tier of presentation and a [search form](#). Or download PDFs of the [full program](#) and the [full book of abstracts](#). (These links might work eventually only for ECSS members.) Or access all abstracts via the [search form](#) or eventually via the [EDSS database](#) (login required). ECSS members can also access videos of plenaries and some invited symposia via the [ECSS.tv page \(eventually\)](#). There are no longer any downloadable PDFs of mini-oral or e-posters.

To find the presentations I have reviewed, copy the presenter's name and initial shown in brackets [...] into the [search form](#), or if you have downloaded the PDF of the abstracts, copy into the advanced search form (Ctrl-Shift-F) in the Adobe Acrobat PDF reader.

My apologies if you can't find your presentation in this report. Amongst the reasons I may have omitted yours: it was too difficult to understand (often because of pointless abbrevia-

tions); the sample size was inadequate (less than 10 subjects per group, case studies excepted); there was little or no relevance to competitive athletes; I was careless; and you reported effects exclusively as p values or just (non-) significance.

### The Wow Factor

Here, in order of appearance under the headings below, are seven presentations that for me were particularly inspirational or insightful: [training and nutrition strategies for healing](#) of connective-tissue injuries; [reduction in injury costs](#) with FIFA 11+ Kids; [coach perceptions to improve objective measures](#) of performance monitoring; [genomics too complex](#) to predict individual trainability; [factors affecting talent development](#) in football; [the ascendancy of big data](#) in team sports; and [biomechanical modeling to optimize equipment](#) for performance or injury. These are highlighted with **Wow!** Unfortunately there were no inspirational training studies this year, but it's the same number of wows as in last year's highly successful meeting, and this report is a full page longer. Evidentially it was another wonderful conference.

### From Lab to Track

Thimo Wiewelhove organized this valuable [workshop](#) at the Ruhr University Bochum on the Tuesday before the conference. We were out of the blocks with a lecture by a world-class expert, Shona Halson of the Australian Institute of Sport. Her topic was performance enhancement of elite athletes, and she focused on preparation for the summer Olympics under three headings: monitoring, recovery, and sleep. For the rest of the day we were treated to a series of lab- and field-based demonstrations

*Monitoring.* Most top-level Australian athletes are now recording training and health status in Smartabase, an athlete data management system. The data show that completing >80% of their training sessions is a good predictor of athletes reaching their goals, hence the need to reduce injury and illness. The data are also providing insights into the training-stress balance, acute vs chronic loads, soreness predicting injury, high incidence of upper respiratory tract issues, poor sleep, and the need for a multidisciplinary approach.

*Recovery.* Shona spoke mainly on cold-water immersion and the logistics of using it on tour. There are definite performance benefits for

acute recovery in tournament settings, but chronic use can impair adaptation, depending on the sport, so it needs to be periodized. Examples: with cyclists, use it to recover before high-quality sessions; use it regularly in team sports with hard weekly competitions; for swimmers, use it just before and during important competitions but "conservatively" at other times. Warm-water immersion for relaxation and sleep in cold environments was suggested in question time.

*Sleep.* Athletes don't get enough! Deprivation may impair performance, and getting more may be beneficial. Coffee and social media (the light from the smart phone and the mental activity) are problems that can be mitigated with various practical strategies, including education. "Eat, sleep, train" is a useful mantra. The Australian swimmers did a training camp at Canberra to promote confidence for the Rio Olympics by simulating racing at night in Rio.

*Lab- and field-based demonstrations.* The Faculty of Sport Science evidently has a comprehensive and practical research program for various sports on altitude training, motion analysis, neuromuscular function, reaction time, performance testing, and vision testing and training. It was not possible to see all the demonstrations. Highlights of those I saw: testing, benchmarking and training of vision in table tennis players, reaction time in football goal keepers, and fitness in tennis players. The researcher demonstrating movement diagnostics (i.e., fitness tests) in field sports was facing the challenge of convincing the football coach of their relevance. I guess you have to provide evidence that they predict performance in matches, for example using the kind of correlational study in handball presented in the session on testing in game sports [WAGNER, H; [see below](#) for my interpretation].

### The Science Slam

From the [ECSS page](#) on this inaugural event: "Science Slam is a communication format whereby young scientists have 10 minutes to explain their research projects in an understandable and entertaining way." There were [eight presenters](#), and the winner was decided by decibels of acclamation. My favorite was Naomi Akamura, who was not only hilarious but managed to communicate something practical about using measurement of muscle hardness to titrate the amount of stretching needed to relax.

The winner, Franziska Lautenbach, told an entertaining story about her PhD using the metaphor of a bus trip, but there was little science. Conclusion: a lot of fun, and worth trying again.

### Acute Effects

I have summarized the abstracts in the order of factors or strategies that apply in preparation for competition, during competition, and in recovery after competition.

"Even minor changes in natural (day-to-day) variation in **sleep** quantity significantly affected cognitive and gross motor performance" over three consecutive days in 98 elite **youth athletes**. [KNUFINKE, M]. But the results were presented only as  $p=0.03$  and  $p=0.04$ , and with repeated measurement in such a large sample, these significant effects would likely be definitively trivial. As always, we need to see an assessment of the magnitude of the confidence limits. (See the [item and slideshow on p values](#) in this issue, if you don't understand how a significant effect can be trivial.)

I can't be sure, but it looks like an unspecified amount of one night of **sleep** deprivation in trained **cyclists** impaired ~1-h time-trial time by 11% (" $p<0.05$ "). [ROBERTS, S.S.H]

"Poor **sleep** was associated with worse age-group rank" ( $r=0.37$ ) in this study of 30 **Ironman triathletes**. [PAHNKE, M]

They was only an unstated number of **participants**, and effects are presented only in standardized units (please don't!), but it looks like extra **sleep** enhances sprint performance. [PITCHFORD, N.W]

"Urine metabolomics" (analysis of the pattern of metabolites in urine) showed changes when **sleep** was disturbed with exposure to bright artificial light in eight **healthy men**. [NAKAMURA, Y]. I wonder if such analysis could be useful in monitoring acute and chronic fatigue.

An unspecified number and type of **athletes** "experienced poor **sleep** following a night game. Further, athletes with a high trait arousal [reported more] sleep complaints". [JULIFF, L.E]

Exposure of **male athletes** to **bright light** for 60 min appears to enhance evening performance of a 12-min cycling time trial, but I missed the presentation and it's not clear what "tenfold increase in exposure to non-image forming light" in the abstract refers to. The

"performance gain... of 6.2%" presumably refers to work, not time. [KNAIER, R]

What kind of **morning exercise** (at 0830) might enhance performance in the afternoon (at 1300)? In this crossover study of 12 **cyclists**, 6x 6-s sprints enhanced 5-km time trial time by a presumably unclear 0.6% compared with control (no exercise), but "ecological exercise" (some anaerobic threshold bouts plus 2x sprints) produced a possible enhancement of 1.6%. [DONGHI, F]

As a result of this crossover study of 20 **male judokas**, the authors suggested performing a "combine" **warm-up** (presumably static and dynamic) before training skills based on speed and strength performance, and a static warm-up before skills to improve flexibility performance. [EKEN, Ö]

Two bouts of active muscle **stretching** are enough to achieve a more than two-fold greater increase in range of motion than static stretching with the same time under loading in this crossover with 18 recreationally **active subjects**. [KAY, A.D]

A **post-activation potentiation** protocol specific for swimming (three sets of maximal isometric contractions in the start position) "significantly" improved 15-m start time of 12 national-level freestyle **swimmers** by 0.07 s. [VIEIRA, L]. This represents a ~0.3% improvement in 50-m time, for which the smallest important change is similar (~0.25%).

It was mainly a mechanisms study of 32 **subjects**, but the results "highlight the potential for [10 maximal] hops as a conditioning activity to **potentiate** subsequent performance" of drop jumps and actions involving the stretch-shortening cycle. [KÜMMEL, J]

Back-squat exercise with elastic bands produced a greater **potentiating** effect on vertical jumps than with free weights in 15 **active men**, although it appears to be a difference in significance rather than a significant difference. [MINA, M.A]

One or two half squats were probably better than three for **potentiating** acceleration in repeated sprints in this study of 20 **athletes**. [GOEBEL, R]

In a crossover simulation of game activity run on a treadmill in the heat, eight **semi-professional soccer players** experienced an increase in core temperature of 2.3°C in the control condition, but increases of 1.9 and

2.0°C respectively when they drank **cool water** and placed an ice towel around the neck during 3-min breaks at 30 min into each half. An extra 5-min break at half time produced an increase of 2.1°C. The changes relative to control were described as *likely large* through *likely small*. Magnitude thresholds were not described and the cooling treatments were not compared inferentially, but even so, drinking cool water is likely to be most effective. [CHALMERS, S]

Use **cooling strategies** before and/or during an endurance run in the heat (33 °C)? Eleven trained male **runners** performed 20 min of pre-load running at 70% VO<sub>2</sub>max followed by a 3-km time trial (lasting ~14 min) in each of four conditions in crossover fashion: pre-cooling by cold-water immersion and ice-slurry ingestion, mid-cooling by facial water spray and menthol mouth rinse, pre- and mid-cooling combined, and control. Compared with control, the athletes ran faster by 2.1% with pre-cooling and by 3.5% with mid-cooling and the combined methods. Enhancements in a longer time trial without the pre-load would be about half these values, and the smallest important enhancement for runners is ~0.3%, so the authors' conclusion that pre-cooling "had little or no influence" is obviously wrong. Allowing for sampling variation, I recommend pre- *and* mid-cooling. [STEVENS, C]

**Iced towels** and a fan plus moisture applied to the skin were equally effective at reducing rectal temperature of **tennis** players during mandated breaks in play in the hot conditions of the Australian and US Opens. [LYNCH, G]

"Coaches should emphasize **stance width** in their instruction for **football goal keepers**, because the small difference [in dive time between a width of 75% of leg length vs 50%, 100% or self-selected width] reflects a travel distance of the ball of 1.2 m in a penalty situation, and a 20 cm longer reach of the goal keeper at ball contact." It was a crossover with 10 elite goalies. [IBRAHIM, R]. I would have given this study a Wow!, if the authors had properly addressed uncertainty in the magnitude of the effect.

**Rock climbers, shake your forearms** beside your body to improve finger-grip performance! [BALAS, J]

A "novel **dynamic tape**" applied to the gastroc improved jump performance (p values only) in 18 **participants** with chronic **ankle**

**instability.** [KODESH, E]

There was a session of six presentations on **pacing** in **cycling** and **winter sports**, which I did not attend. [OP-PM31]. The presentation with the most practical application: "Performance at the start [of ski cross and snowboard cross] is crucial for succeeding in the race. Therefore relevant movement parameters for a good start have to be investigated and then trained systematically." [SPITZENPFEIL, P]. Biomechanical analysis of the start in this study is reported in a separate abstract, with results "suitable for recommendation for coaches and athletes". [OLVERMANN, M]

Sixteen U-19 elite **soccer** players showed no decline in performance when they immediately repeated the Loughborough soccer-specific repeated sprint ability test, even though their perceived **fatigue** was way higher. [O'REILLY, J]. Maybe cognitive skills suffered, as shown by the next abstract.

"Mental and physical **fatigue** impaired reactive agility and **basketball** skill performance" in 11 male, recreational basketball players. [SMITH, M]. Sure, but the mental fatigue was the Stroop test, which no coach in her right mind would get athletes to do before a match.

A computer-based cognitive task performed between small-sided games induced extra **mental fatigue** in 40 young **soccer players** that might increase resistance to mental fatigue in games, if included in the training program. [BOSIO, A]

I missed the symposium on individualization in **recovery**. The first presenter highlighted the need for "individualizing cut-off values for single markers and/or joint consideration of several parameters". Unfortunately the abstract is of the results-will-be-presented variety, but [see below](#) for my summary of her co-worker's application of the method. [HECKSTEDEN, A]. The second presenter's abstract is also minimally informative, but see my summary of her presentation in the satellite symposium above. [HALSON, S]. The only practical advice in the abstract of the third presenter was "grouping together players exhibiting similar chronotype in shared rooms to prevent **sleep disturbance** during training camps and/or away competitions". [NEDELEC, M]

A single exposure to **sauna** post-exercise impaired performance of 20 well-trained **swimmers and triathletes** in the following swim-

training session. "Athletes should abstain from sauna bathing prior to competition and hard training sessions", although carefully planned long-term use may be beneficial. [SCHIMPCHEN, J]

"Whole-body **compression garments** and neuromuscular electrical stimulation do not promote recovery [of blood biomarkers, perceived wellness and countermovement jump] after a cross-country elite sprint **skiing** competition." [GOVUS, A]

When a reputable researcher gives a symposium presentation on **foam rolling**, you have to take it more seriously. Reduction in pain and increase in range of motion are the main claims made for benefit. [BEHM, D]

A crossover study with 18 semi-professional **football players** showed that eccentric-based **injury-prevention exercises** should be scheduled 1 d rather than 3 d after a game, to reduce exercise-induced muscle damage and soreness before the next game. [LOVELL, R]

**Injury**

**Wow!** Keith Barr gave a symposium presentation on his amazing in-vitro studies of "engineered ligaments... suggesting that short (<10 min) periods of activity with relatively long (6 h) periods of rest are best to **train** these tissues. Further, the addition of **nutritional interventions**, such as gelatin [and leucine-rich protein], can augment collagen synthesis". He presented case studies of **ACL rupture** where application of these insights resulted in remarkably quick return to play. His "clinical take-away" slide included two additional points: copper-rich foods may help offset the four-fold higher risk of ACL injury in women, and heavy weightlifting of an unaffected area of the body could improve healing of a **connective-tissue** injury. [BARR, K]

**Wow!** The **FIFA 11+ kids** warm-up program for **football** reduced not only the risk but also the average severity (cost) of injury in a controlled trial of 1035 Swiss children age 7-12 y. The total cost was reduced by a factor of 0.38 (62%). [RÖSSLER, R]. This was the last presentation in the last session. Don't leave the conference early!

A **modified FIFA 11+** injury-prevention program appeared to work better than the 11+ in two youth **soccer** teams over one season. There are no details of the modification in the abstract, and the stats are obscure, but it was a

persuasive talk. [ASGARI, S.M]

Incredibly, less than half (44%) of German **football** coaches had heard of the **FIFA 11+**. Response rate was only 16%, but there was no substantial difference between early and late responders, and anyway, non-responders could be even less likely to know about it. [WILKE, J]

From the symposium on performance and injury in **football**... "Under stressful conditions, athletes may experience a narrowing of their peripheral vision, which increases their risk of **acute injury**. High trait anxiety, high life stress, and low social support increase injury risk. Cognitive behavioral interventions focused on **stress management and relaxation** reduce the risk." [PODLOG, L]

From the same symposium... "Disease prevention based on appropriate **hygiene** is surprisingly successful in studies outside **football** and may provide the basis for football-specific strategies.... Approaches designed to predict injury proneness on the basis of testing players' functional properties [e.g., the **functional movement screen**] have failed, [but] various programmes have been developed [e.g., the **FIFA 11+**] which can be used without the need to tailor them to the individual player." Attempts are underway to make the 11+ less boring and more appropriate for high-level players. [MEYER, T]

Notwithstanding Tim Meyer's pessimistic assessment of the **functional movement screen**, it did predict injury in several presentations at this conference. The issue is therefore whether the predictions are strong enough to warrant preventative interventions with individuals. Total and some component scores of the functional movement screen prospectively predicted injury over a season in 41 high-school women **volleyball** players. We need to see hazard ratios, not differences in means between injured and uninjured players. [IDE, Y]. A score of  $\leq 14$  in the functional movement screen predicted twice the risk of injury in the following season in this prospective study of 83 amateur male **soccer** players. Core-stability items appeared to be responsible. [KOLODZIEJ, M]

Approximate doubling of risk of non-contact (i.e., load-induced) injury in **football** was associated with a very low sprint-distance acute:chronic ratio ("a significant **training de-load**"). The training predictors were analyzed

as five levels (quintiles), which reduces the power and increases the risk of Type-1 errors with small datasets, so I am somewhat skeptical of the findings. [COLBY, M]

"**Fascial manipulation** was effective in improving equilibrium, range of motion, symptomatology" and probably reduced **ankle injuries** in a controlled trial of 20 **footballers** with chronic ankle instability. [BRANDOLINI, S]

"Multimodal **injury prevention programs** beneficially affect several neuromuscular performance measures" in a meta-analysis of 17 randomized controlled trials in youth sports, predominantly **football**. Effects were small-moderate in sprints, balance and dribbling. [FAUDE, O]

Introduction in 2006 of a red card in case of intentional elbow to head contact was followed by small-moderate reductions in **head injuries** in **football**. [BEAUDOUIN, F]

"**Genetic variants** appear to be involved in the aetiology of **hamstring injuries**, but had no predictive ability" in this study of 107 male **football** players followed for six seasons. [LARRUSKAIN, J]

In this controlled training trial of 28 recreational **volleyball** players, "a single, video-assisted augmented **feedback intervention** may improve landing biomechanics in a counter-movement jump with single leg landing" and thereby reduce the risk of **ACL injury**. [BOSSARD, D]

The "waiter's position" for **servicing** in **tennis** induced higher **upper limb** joint loads, with no [improvement] in ball speed, so it could increase the risk of injury. [TOUZARD, P]

Various acute:chronic training **workload** ratios were associated with risk of unstated type of injury in 58 male and 43 female **tennis** players over an unstated period. [GESCHEIT, D.T]. The odds ratios appear to be unrealistic uninterpretable linear beta coefficients.

Reducing stride length produced lower-limb loading and **knee pain** in one **runner** with knee pain but had opposite effects in another, highlighting the need for "a more individual approach to injury-prevention training". [DOYLE, S]

"A higher body-mass index is a risk factor for **ankle sprains** and for injuries in general, and higher weight is a risk factor for ankle sprains" in a meta-analysis of anthropometric risk factors in 10 studies of **military personnel** and 29

studies of **athletes**. [MELLONI, M]

A case-control study of 20 **tackles** that caused **cervical injury** and 102 that did not in Japanese collegiate **rugby** revealed that "tackles are likely to be successful and to prevent cervical injuries if tacklers contact the chest region of ball-carrier, or their heads are placed in the rear of ball-carrier". [SUZUKI, K]

If you are interested in **injuries** in elite youth **alpine ski racers**, you will have to decode the pointless abbreviations in this abstract. [MÜLLER, L]

### Nutrition

The anti-oxidant and/or anti-inflammatory effects of **phytonutrients** show mostly positive effects on recovery and muscle damage when administered acutely, but "the longer-term effects [on training-induced adaptations] are still largely unknown". [STEVENSON, E]. Why are we still in the dark on this issue, fully five years after Jo Bowtell's memorable presentation on "**berries and cherries**" at the **Bruge ECSS**? The author (Emma) suggested several explanations in her presentation and in a follow-up email: there is a wide variety of foods that could be investigated, optimal acute dosage and timing need to be established first, and diet-controlled training studies are difficult and costly. I wondered if negative effects in industry-sponsored studies have yet to be submitted for publication, but Emma thought that was unlikely.

I opted to attend presentations other than the symposium on **dietary nitrate** (including **beetroot juice**) as an ergogenic aid. According to one abstract, it enhances performance in untrained individuals, the potential mechanisms being "alterations in skeletal muscle contractile and mitochondrial function, and blood flow". [VANHATALO, A]. Apparently it's still unclear whether it has substantial benefit for **highly trained individuals**. [VERDIJK, L]. The abstract on practical application and future research with **athletes** is uninformative, but the presentation is bound to have been useful. [BURKE, L]

**Beetroot juice** consumed by nine **recreationally active males** before and during a 4-km cycling time trial (preceded by a 2-h pre-load of moderate intensity) produced a 3.0% *impairment* in time compared with consuming placebo. But with " $p > 0.05$ ", the authors concluded that "completion time did not differ". We need

to see the confidence interval and smallest important effect. [TAN, R]

If anything, **nitrate** supplementation impaired performance (by 6%) of 10 **recreationally active males** in a ~3-min time-to-exhaustion cycling test at constant power following 3 d of a high carbohydrate diet. A **high-fat diet** for 3 d impaired time to exhaustion by ~15%, unsurprisingly. [PIATRIKOVA, E]

However, **beetroot juice** produced an improvement in ~60-min time-trial time of 2.7% relative to placebo in the heat but only 1.7% at room temperature in this crossover with 12 male **cyclists** of reasonable ability ( $VO_{2max}$  66 ml/min/kg). Effects were not significant, so the title states "does not improve performance." [KENT, G.L]

The abstract summarizes **nutritional strategies** for optimizing **elite endurance** exercise performance, but there are no surprises. [JEUKENDRUP, A]

Compared with placebo, the changes in peak power in repeated 4-s sprints in the heat when 12 trained **team-sport athletes** consumed **caffeine** with or without carbohydrate were 2.4% and 4.2%. The overall effect was not significant, so the authors concluded caffeine did not improve performance. [ROSS, C]. This conclusion is consistent with other evidence that chronic use of p values is associated with substantial cognitive impairment. The effects on mean power were less (2.9% and 0.5%), which fits with the idea that you get higher peak power in the first few sprints but pay for it with fatigue in later sprints (Paton and Hopkins, long ago).

Seven male **team sports** players experienced likely to very likely substantial improvements in mean and peak power output in repeated 30-s (Wingate) sprints with **taurine** and/or **caffeine** compared with placebo. Unfortunately there are no data in the abstract, so we can't see if the effects of taurine and caffeine were additive. [WALDRON, M]

Eight **healthy males** experienced a 6.7% increase in performance time in a ~30-min time trial in the heat following consumption of **tyrosine**, and there was about half the effect on half the dose, allowing for sampling uncertainty. Oh, but it wasn't significant, so "tyrosine did not influence prolonged exercise performance in the heat, irrespective of dose." Then the authors launched into explanations for the lack of

an effect. [TUMILTY, L]. More evidence of cognitive impairment?

Throwing a bean bag improved with **tyrosine**, but "the N-back task" (not described at all) did not improve in a crossover with 26 **males** and 16 **females**. I don't understand the conclusion that the improvement in motor performance "did not operate via challenge and threat states". [HASE, A]

Are the effects of **creatine** and **post-activation potentiation** additive for explosive strength? Apparently not, but there aren't enough data from the 17 **kayakers** in the abstract to tell, and it's confusing. [WANG, C.C]

Fifteen average male **cyclists** who supplemented with **hydrolyzed keratin** for 4 wk gained nearly 1 kg of DEXA-measured "bone-free lean mass" compared with when they supplemented with **casein**. The gain in the legs was 2.5% net. No mention of performance. [STANNARD, S]

Bitter (**quinine**) and sweet (unstated) solutions ingested 30 s prior to 3-km time trials enhanced mean power output by ~2% relative to water (control) in nine well-trained male **cyclists**. The enhancement with quinine in the first minute was ~5%. Is this all placebo effects? [ETXEBARRIA, N]

"The present results [p values in the experimental group only] support previous positive effects of **protein supplementation** at promoting positive body composition outcomes in endurance athletes." It was a beef-and-why beverage consumed by **resistance-trained males** over 12 wk. [MORENO-PÉREZ, D]

### Performance Analysis and Monitoring

**Wow!** Sigmund Loland gave a wonderful account of the [mind-body problem in sport](#) in his incoming presidential address at the Liverpool meeting in 2011. His conclusion: the coach can see things that the sport scientist cannot yet (or possibly ever) measure. Now an Australian group led by Aaron Coutts has included **coach perception** of current ability of nine **swimmers** over nine months to improve the predictions of the Banister fitness-fatigue model based on **training load** and **physiological measures**. The abstract does not mention inclusion of coach perception or percent prediction error. [CROWCROFT, S]. I wonder if the coach was quantifying mainly the swimmers' "feel" for the water (the mind), which of course is missing from any objective monitoring (the body).

The Banister **fitness-fatigue model** for predicting performance can be improved by adding a "preload", but the prediction error of 3.7% (for what measure in a tethered swimming test?) still seems impractically large in this study of five elite **swimmers**. [LUDWIG, M]. The prediction error of 6.8% with a mixed model for 10 elite **swimmers** is even worse. [RODRÍGUEZ, F.A]. Predictions with the "Performance-Potential-Double-Model" had a much smaller error of 0.8% for 1000-m speed on a rowing ergometer with four elite **rowers**. [RASCHE, C]. But even this error is impractical, considering that the smallest important change is ~0.3%.

Using a **Bayesian approach** to monitoring an **individual athlete**, by incorporating previous test data in a probabilistic fashion, is a promising approach, provided the measure you are monitoring is meaningful and you have some idea of important changes or thresholds. [PITSCH, W]

Changes in pituitary and adrenal **hormones** in 30 **cyclists** during an 8-d tour revealed no differences between acute **fatigue** and functional **over-reaching**, so it's not worth monitoring them. [TEN HAAF, T]

Changes in the Lamberts submaximal running test following an **ultramarathon** were similar to those indicative of performance readiness (lower submaximal heart rates, faster heart-rate recovery), except that the **runners** reported high muscle soreness and fatigue. Hence combining **subjective** and **physiological monitoring** might help forestall overtraining. [LAMBERTS, R.P]

**Perceived stress** affects various performance indicators of various **endurance athletes** in a submaximal test over 1 y of monitoring. "Athletes and coaches could benefit from monitoring psychosocial factors." [OTTER, R.T.A]

**Pacing** of junior Dutch **speed skaters** changes as they develop to the elite level. [STOTER, I.K]

In an analysis of **serve patterns** (the first three strokes) in US and French Open **tennis** tournaments, "placing the [third] stroke in specific zones of the court and the use of the forehand are key to playing the serve pattern successfully and winning matches in general" [BORN, P]

Biomechanical analysis of the **tennis serve** in elite junior tennis players revealed differences

between boys and girls and between age groups highlighting the importance of several factors in achieving high serve velocity. [GATZKE, D]

"Elite female **soccer** players with better **endurance** [tested pre-season] played more during the season..., [but] no significant differences were observed for an interval shuttle-run test." [ARAÚJO, M.C]

Six **football** performance analysts and coaches "were able to reliably describe the development and loss of **defensive balance** within attacking sequences... Defensive balance seems to be a promising concept which can be applied by experts in order to further study playing efficacy." [SCHULZE, E]

Significance of differences between a **basketball** team's mean scores with different **referees** was used to determine that on average 10% of 56 referees were "unsuitable" for a given team. So, "the referees assigned to a game should be selected from the referees who is suitable for both teams." [WANG, S]

If you are a top hurdler, you might like to make sense of this analysis of **hurdles contact** and performance in Japanese domestic and international 110-m hurdle races. [IWASAKI, R]

**Maximum fat oxidation rate** and VO<sub>2</sub>max had correlations of -0.35 and -0.67 with race time in 61 male **Ironman triathletes**. The multiple R was 0.72. [FRANDBSEN, J]. The correlation for fat max is probably not high enough to warrant speculative advice for training.

The correlations between "general" **field or lab tests** and game-based measures of performance in 72 experienced male **handball** players ranged from 0.19 to 0.41, "clearly indicating that general tests are not suitable to predict team handball specific performance." On the basis of findings in other team sports, "performance tests including different specific movements and a frequent change of intensities are essential to determine specific team sport performance." [WAGNER, H]. The authors concluded with a call for additional studies. Yes, and they should investigate the extent to which the general and specific test measures track *changes* in game performance: a measure with a poor cross-sectional correlation may still be useful for monitoring.

Other correlates of performance: **physiological measures** in 21 **mountain bikers** [ENGELBRECHT, L], **physiological** and **bio-**

**mechanical measures** in 21 **race walkers** [SANTOS-CONCEJERO, J], **jump** and **sprint tests** in 1068 **fencers** [MENTZ, L], **anthropometry** and **fitness tests** in 41 elite female **basketball** players [TORRES-UNDA, J], **rotation** (substitution) **factors** on player rating scores in 33 **Australian footballers** [COUTTS, A], **body composition** in 18 male **lacrosse** players [HAUER, R], **movement coordination** in six **air pistol shooters** [CHEN, H.H], **lab-based factors** in 28 **biathletes** [LAAKSONEN, M], **team performance indicators** in UEFA Euro **football** 2016 [ZAIZAFOUN, F] and in the China Super League (presumably **football**) [GAI, Y], and **upper body power** in 16 **swimmers** [TAKEDA, M]

### Talent Identification and Development

**Wow!** In his plenary *Individuality—a Physiological Perspective*, ECSS past president Hans Hoppeler reviewed studies showing that maximum oxygen uptake and **trainability** of maximum oxygen uptake have substantial **heritability**, but genes have failed to explain the individual differences. He quoted famous geneticist Claude Bouchard's call for a paradigm shift in exercise **genomics**. He then stated that trainability is an emergent property that cannot be understood via a reductionist approach to the impossibly complex behavior of the underlying genes. In plain language, we can study individual differences in trainability from the top down (e.g., effects of personality and experiential factors), but we will get nowhere by studying it from the bottom up with genomics, transcriptomics, proteomics, metabolomics, and/or epigenomics. [HOPPELER, H]

For a more optimistic (but unrealistic?) view of **genomics** of **individual responses** to training, see the symposium on the individual human phenotype. [WOLFARTH, B; BLOCK, W]

**Wow!** I recommend viewing the videos of the two presentations in the plenary session on **development of talented players** to world champions in **football**. Mark Williams' key points on development: expertise is multifaceted and acquired by deliberate practice—no gene or other measurable factor accounts for differences in performance; coaches are doing too much performance-based training sessions and not enough self-learning-based sessions; and players disadvantaged by the relative-age effect on physical skills early in their career compen-

sate and get a later advantage via technical and tactical skills. [WILLIAMS, M]. Tim Meyers' key points on lessons from the football World Cup in Brazil 2014: support staff in professional clubs feel pressure to present innovations to demonstrate they are needed, resulting in too much scientific diagnostics; and there is a need for reliable (I think he meant valid) measures for monitoring individuals (e.g., self-reported measures work less well in tournament or regular competition settings, because players lie). [MEYER, T]

"**League systems** in **individual [non-team] sports** supplement the individual competition system in a beneficial way." So if you are considering introducing such a league system, read this abstract of the German experience. [ZIMMERMANN, T]

In a 7-y retrospective study of **performance development** in junior **tennis** players across 2-y age categories, significant developments in nearly every parameter were not surprising, considering the huge sample size (>5000). Correlations supported the assertion that "intervention programs focusing on power of the upper extremity are urgent to be implemented". [FETT, J]

There were abstracts on the **relative-age effect** in a **football** club [GIL, S.M] and in Swiss **sports**. [ROMANN, M]

Test-retest reliability correlations of components of the **Fulda Movement Check** with elementary **school children** over a 5-y period ranged from 0.55 to 0.27. I don't think these are high enough to support the claim that "talent screening at elementary school age is a feasible solution to indicate the talents of tomorrow." [SIENER, M]

Prediction of future **soccer** performance also seems to me to be too low ( $r = 0.36$ ) for the **German Motor Test** plus ball throw to be "a worthwhile instrument for predicting youth soccer performance". [PIETZONKA, M]

An analysis of the recall of **sport participation** in childhood (up to age 12) of Swiss junior regional **football** players showed that engaging in more football-related activities increased the chances of reaching the junior national team. I'd be worried about biased recall. [SIEGHARTSLEITNER, R]

**Coach autonomy support** can stimulate youth **soccer** players to engage in additional soccer-related activity, according to the analysis

of data provided (in questionnaires?) by 527 players aged 11-15 y. [GJESDAL, S]

See [my report](#) on the Olympic conference last year for [a summary](#) and link to the abstract about the factors possibly making Perth a **sporting "hotspot"**. The current abstract contains similar information from the same study. [O'NEILL, K]

### Tests and Technology

**Wow!** The symposium on **big data** was the best of all the sessions I attended. A pity it's not available on ECSSStv. If you are interested in software for management, analysis and prediction in **football** and other complex **team sports**, read on.

The first speaker, from the business software giant SAP, presented "the developer perspective" on [SportsOne](#), a "team-management" solution for monitoring injury and training. Although SAP decided initially that the market for analysis was already too competitive, they do provide some analysis for the football version and will add machine-learning analysis for other sports. The software interface is sophisticated and user-friendly, so it is less likely to be a "data cemetery". The abstract is not particularly informative. [MCCORMICK-SMITH, A]. Andrew, cool!

The second speaker is the director of Data Science with [STATS](#), a corporation specializing in sports statistics. His presentation on "the analyst's perspective" was so good that I am considering bringing forward my full retirement. His focus was machine learning from the spatio-temporal data that are now available for thousands of matches in football and other team sports, allowing probabilistic assessment of best tactics, including even best positions of players for attack and defense, displayed on screen with "ghosting" (grey icons showing best positions). Best strategies will be investigated via game simulations with identified players in both teams. As if that's not enough, they are developing automatic 3-D analysis of game videos to display "body shots". He stated that the aim is to develop software that will help domain experts (the analyst and the coach) do their job better. A particular issue in this regard is that coaches prefer analyses that are interpretable as well as accurate, so the STATS analysts are finding ways to make the black box of machine learning more transparent (my words). The abstract is reasonably informative. [LUCEY,

P]. Patrick, simply amazing! Reflecting on his presentation, I now wonder if what can be described as traditional team-sport analysts will lose their jobs in the near future: for matches at lower levels that don't get the commercial spatio-temporal coding from the likes of Opta or ProZone, pay to get them done with the salary saving on the analyst.

I thought the third speaker, who gave "the sports perspective", would be intimidated by the first two, but she gave a masterful overview of the state of her analyst's art. Her abstract, which is worth reading, concludes with "a more substantial research effort is needed to develop prospective mathematical models, which convert a vast volume of data into a reduced set of useful variables for decision making," [VOLOSSOVITCH, A]. Anna, well said, but STATS is doing that for the sports it compiles.

**Wow!** If you want to improve performance or reduce injuries via the athlete's **equipment**, call in a biomechanics expert to do some sophisticated **modeling**. We were treated to several impressive examples, most memorably optimization of the clearance between the sled and ice in **skeleton**, and assessment of **ski** bindings with an artificial knee. [SENNER, V]

You can now measure perceived stress and recovery with a new validated questionnaire, the **Short Recovery and Stress Scale**, which was developed in a factor-analytic study of 574 **elite athletes**. [KELLMANN, M]

**Muscle typology** determined non-invasively with **magnetic resonance spectroscopy** can predict fatigue and recovery profiles in this study of 21 male **participants**, so the method "may have important applications as a non-invasive tool for individualizing advice for muscle recovery from intensive training in sports." [LIEVENS, E]. I wondered if a lower-tech less expensive and more practical method based on direct muscle stimulation and force measurement would be just as good.

The authors tested enough talented young **judo** athletes (154 males, 107 females) to provide percentiles for a new judo-specific **beep test**. [KIRBSCHUS, K]

In a cross-sectional study of the effects of age and playing position of 154 elite **soccer** players (in three age groups) on speed and accuracy in the **Footonaut passing test**, the only significant effect was for age on speed. Unfortunately the F and eta statistics are uninterpretable.

[SAAL, C]. The test-retest reliability for this test would tell us how well it categorizes players.

Random error in the speed of **tennis** serves measured with **PlaySight SmartCourt's** four-camera system is unacceptably high (5% to 9%). [OBERSCHELP, N]

The **Fitbit Charge** was incredibly bad at recording heart rate during exercise in 20 **participants**. [SANDERSON, M]

"Adjustments for plasma volume [with markers from a simple blood test] has the potential to significantly improve the sensitivity of the **athlete biological passport** [to detect blood doping]". [LOBIGS, L]

Biomechanical measures in a **golf-specific rotation movement** have good reliability and validity (correlation with club-head speed measured with radar). [PARKER, J]. Why use the test when you can use club-head speed?

Main point from a symposium presentation: there is no clear evidence as to which of the measures of perceived exertion, heart rate, GPS is the best to quantify **training load** in **football**. [NASSIS, G]

18-Hz GPS had half the errors of 10-Hz **GPS**, but a 20-Hz local positioning system was even better: half the errors (~1-5%) of the 18-Hz GPS, when six **recreational athletes** performed repeated trials of soccer-specific movements. [HOPPE, M]

Use of a **smart phone** to record **food intake** showed poor compliance, especially with recording of snacks, with 22 players from an English premier **football** academy. "It may be advisable to use a more traditional methodology, such as the 24-hr recall, to support any smart-phone methods." [NAUGHTON, R.J]

The **Delsys wireless sensor** provides instant feedback on **joint angles**, but it had poor validity in eight **males** when compared with Vicon 3-D analysis. [HO, H.Z]

"The portable and inexpensive nature of the **Kinect** could offer an effective solution to conduct the **functional movement screen** in applied settings" in this study of 23 **adults**. [SMITH, P]

A miniaturized face-worn **VO2 analyzer** tested over the range 1-4 L/min with a mechanical **respiratory simulator** has a systematic error of ~-5%, which could be recalibrated. The random error of 2.1% to 3.5% "is similar to the most popular lab carts and even below some of

the portable systems currently available on the market". [VAFA R]. Maybe. It looks promising.

### Training

Replacing one of two weekly sessions of conventional **tennis** training with non-specific "**adaptability training**" for 12 wk produced better scores in a tennis-specific accuracy task and more enjoyment in this randomized controlled trial of 49 unspecified young athletes. No data, just a difference in significance. [POTTER, A]

A meta-analysis of over 100 studies revealed that "**youth strength training** programs provided similar improvements in power measures as **power training** programs, contradicting the training specificity principle. In general, youth may not possess a sufficient foundation of strength to optimize power training adaptations." [QUIGLEY, P]

In another meta-analysis comparing **strength training**, **endurance training**, or both (concurrently) on strength, power and/or endurance in **youth athletes**, there were only seven studies and what looks like "not available" for some estimates, so I think more studies are needed before you can conclude that concurrent is best. [GÄBLER, M]

**Polarized training** for 6 wk resulted in a 3.3% improvement (in race time, presumably) vs 0.5% with (anaerobic-) threshold training in this controlled trial of 32 national **swimmers**. But the difference was "not significant", so the authors concluded that "polarized training and threshold training have similar effects on swimming performance". Sigh... [PLA, R]. Actually, that large effect should have been significant with that relatively large sample size. Something wrong here?

"Low volume high velocity/force **resistance training** programs are recommended" to improve **swimming** performance, in this meta-analysis of 14 studies focusing on competitive swimmers. No data are shown. [CROWLEY, E]

"Specific **strength training** can be concurrently performed with repeated sprint training to enhance [pre-season] **futsal** [test] performance" in an underpowered 5-wk controlled trial of 14 players. [PHONGSRI, K]

Higher **training variability** (within or between sessions?) during 3-wk microcycles was apparently associated with superior physical performance in games at the end of the micro-

cycles over a season in a professional **football** team (Barça B). I can't understand the methods. [FERNÁNDEZ, J]

When 26 young elite **soccer** players trained twice per week for 8 wk with alternation of **balance** and **plyometric exercises** vs a block of balance before a block of plyometric exercises within each training session, there were no significant differences between the two groups in the large changes in performance tests. OK, but you need to show effects and confidence limits, so we can see if your study was underpowered. [CHAOUACHI, A]

Viewing **videos** of themselves "edited to show only adaptive behavior" was only partially successful in improving performance in this case study of four elite youth **football** players over a season. [MIDDLEMAS, S]

Main point about **periodization** in the abstract of a symposium I missed: "The traditional way of implementing high-intensity training is to regularly perform ~2 sessions per week interspersed with low and moderate intensity endurance training. However, organizing the training in distinct blocks with selective focus on one or a few training stimulus can be a good alternative for certain training periods in elite **endurance athletes**." [RØNNESTAD, B.R]

Should you use **traditional or daily undulating periodization** (neither were described) with loaded jumps to enhance jumping and sprinting performance? There was no significant difference in the changes of various measures in this 6-wk study with 22 regional elite **team-sport athletes**, but no data are shown in the abstract and the study may have been underpowered. Next time please show data and confidence limits so we can tell. [ULLRICH, B]

In a randomized controlled trial of 6 wk of **traditional vs undulating periodization** of loaded vertical jump training with 20 **amateur athletes**, the percent gains in jump performance of the undulating group were about twice those in the traditional group. Lack of significance produced a predictable schizophrenic interpretation. [PELZER, T]

"Regular **active recovery** during a high-intensity interval-training [4-wk] mesocycle does not attenuate training adaptations" in several measures of endurance performance in a controlled trial with 26 well-trained **intermittent sport athletes**. Percent effects and confi-

dence limits would be preferable to the standardized effects and p values shown in the abstract. [WIEWELHOVE, T]

There was little effect on a countermovement jump, but the gain in 1-RM leg press when the **subjects** recovered from 8-9 wk of strength training sessions with **cold-water immersion** was half that in the control condition (no recovery). Not significant, but at least the authors suggest that "a cooling-induced attenuation of strength training adaptation cannot be ruled out." [POPPENDIECK, W]

Adding "**inspiratory muscle recovery**" to sprint interval training didn't add any extra improvement in endurance performance in a controlled trial of 22 collegiate male **athletes**. (Another 11 athletes were wasted on a no-training control group.) [CHENG, C.F]

From the abstracts of a symposium on hot topics in **altitude training**... "Three weeks after return [from altitude training], when already 50% of the gained hemoglobin mass has disappeared, best [**endurance**] performance has been determined." [SCHMIDT, W]. Combining

"traditional" live-high train-low altitude training with sprint training in hypoxia produced "twice larger gains [in repeated sprint ability] that were maintained at least for 3 wk post-intervention in elite **field hockey** players." [GIRARD, O]

In this study of 5 female and 19 male **runners** assigned to two live-high train-high **altitude-training** groups (1600 m and 1800 m) and near sea-level control, "the larger [~1%] improvements in performance observed after live-high-train-high may have been due the greater overall load of training in hypoxia compared to at sea-level." But hemoglobin mass did increase in the two altitude groups, so it was probably more than just the training-camp effect. [SHARMA, A]

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