Effects Went Away at the 2013 Annual Meeting of the European College of Sport Science

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This highly successful conference was noteworthy for its venue, logistics, and research wow factor, including unexpected failure or harm with nitrate supplementation, carbohydrate mouth rinse, and even regular exercise. Accessing Abstracts and Videos: links to all abstracts, to poster PDFs, and to videos of the plenary sessions. Non-Athletic Populations: genes predict positive and negative responders to exercise; conference session summary and search strategies. Acute Effects: re-warmup; post-activation potentiation; ischemic preconditioning; cycling position; recovery; titanium-impregnated garments; stretching; shoes; timeouts. Injury: reaction time as a risk factor; prevention strategies. Nutrition: status of carbohydrate train-low compete high; antioxidants and the hormesis hypothesis; acute effects of tart cherry juice, NAC, green tea, nitrate, carbohydrate, caffeine, paracetamol; longer-term effects of beta-alanine, oral contraceptives. Performance Analysis: environmental effects, triathlon, basketball, rugby, soccer, speed skating, swimming. Tests, Technology and Monitoring: transcriptomics; instrumentation for rowing and kayaking; tribometer for frictional drag of skis and clothing; ski-snow interaction; heart-rate variability. Talent Identification and Development: spending money; sport for all; assessing nations; genotyping; selection criteria in skiing, soccer, triathlon. Training: psychomotor optimization; contextual interference in tennis; differential learning in badminton; deliberate play vs practice in soccer; sensory-perceptive exercises in swimming; error feedback in golf; skill-retention with video games; video for volleyball; structured for basketball; medicine balls for handball; reducing interference of strength and endurance; resistance for water polo; strength for cycling, soccer, rugby; core for swimming; individualized for cycling; HIT in soccer; vascular occlusion and hypoxia for team sports; intermittent hypoxia for AFL football; high-high-low altitude for swimming. Reviewer's Comments: issues with e-poster format and quality of topics, slides, and speakers. KEYWORDS: competition, elite athletes, ergogenic aids, nutrition, performance, talent identification, tests, training.

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Update Aug 23. The list of all the winners and finalists of the Young Investigator Awards is now available here.

Update Aug 6. A sport-nutritionist colleague, Andrea Braakhuis, has pointed out that **beetroot** juice contains phytochemicals that could contribute to the effect of the **nitrate** it contains. Perhaps, but the "decline effect" and the level of training of the subjects can explain any differences between the published effects of nitrate and beetroot juice containing nitrate, and I still think it is inadvisable to prescribe beetroot juice or nitrate to highly trained endurance athletes for competitions until there is more evidence not only about mean effects but also about individual responses in such athletes.

Update July 24. ECSS has now made the **poster PDFs** available via the search form at the Scientific Program page. As explained below, this search form will stop working in September, after which you will have to be a member of ECSS to search for abstracts and PDFs from this and previous conferences. Join ECSS via the membership page.

Once again ECSS turned on a winning annual conference, this year at the monumental venue

of the 1992 Barcelona Olympics. I arrived a day early with two of my PhD students, so we used the cheap and efficient Metro to do the Gaudi architecture and other tourist spots around the city before the meeting. It struck me how today's conference tourists are like medieval pilgrims: their excuse for travel was inspiration from the relics of saints; ours is inspiration from the research of savants.

The **conference theme** was *unifying sport science*, and in the welcome message in the final program, conference organizers Natàlia Balagué and Carlota Torrents explained that "the 2013 ECSS Congress in Barcelona seeks to help sport science make its own leap forward towards an understanding of ourselves not as part of a technical world but as interacting parts of an indivisible whole: nature." Natàlia, Carlota and Robert Hristovski developed this theme quantitatively in a presentation [Balagué, N]. Sport philosopher Kalle Jonasson challenged her by asserting that a sense of unification may be better achieved via the technical world, which he claimed is a common ground between the disciplines of sport science [Jonasson, K]. There is no doubt that the big leaps forward come from new techniques and technologies, and a good example at this conference was genomics. But in a message to me, Natàlia argued for unification through the new conceptual frameworks that account for complexity, self-organization, emergent phenomena and so on. So my advice to sport scientists is to devise new ways of doing and understanding things and to apply new ways that others have devised in your own and other disciplines.

Whatever its theme, the conference was an outstanding success by all the usual criteria. Check out the statistics and logistics in the official debrief, and view an inspirational 6-min video summarizing the conference. Congratulations to Natàlia, Carlota, their volunteers, and the ECSS conference team: you've set a new world record for the organizers of the next ECSS conference to beat in Amsterdam.

Most importantly the conference was outstanding from the perspective of the wow factor of the research. The title of this report refers to some of the biggest wows: previously promising strategies for performance enhancement that now appear to have stopped working. This "decline effect", which has been documented only recently in medical research (see this article in the New Yorker for a popular account), is a manifestation of publication bias arising mainly from the null-hypothesis test. Follow these links for the most notable effects to decline at this conference: nitrate/beetroot supplementation and carbohydrate mouth rinsing. Here's my choice of other presentations scoring high on the wow factor: paracetamol for repeated sprints and endurance; full instrumentation of a kayak; contextual interference for a perceptual-cognitive skill; video games to reduce loss of skill; intermittent hypoxic training for footballers; and live-high train-high-low for swimmers. The reviewer of this article opted for "no pain more gain" in a symposium on strength training.

The presentation with the greatest impact for me was Claude Bouchard's plenary presentation on the adverse and potentially harmful effects that **regular exercise** can have on a small proportion of **sedentary individuals**. See my critique below. The take-home message is that there is a wide range of **individual responses** to training in the population. The range will in some sense be less for effects of physical **training** on **athletes**, because all those who respond poorly to exercise won't ever be selected into high-intensity sports. Nevertheless, Bouchard's presentation reminds us that there are bound to be substantial individual responses amongst athletes to most kinds of training and other strategies aimed at performance enhancement, and we should estimate and try to account for such individual responses in our research.

The presentation of the **young investigator awards** is always one of the high points at ECSS. This year research on **athletes** in one form or another was better represented than in previous years. The winning podium presentation was an application of self-determination theory to the issue of the coach's role in sport enjoyment [Smith, N], the winning poster was a biomechanical study of tendons in Kenyan runners [Kunimasa, Y], and the winner of a new nutrition award sponsored by Gatorade was a study of the effects of training on carnosine loading in athletes [Bex, T]. View all the winners and finalists here.

It was great to see more presenters this year interpreting **magnitudes of effects** and their **uncertainty**, although I expect the final demise of the null-hypothesis test and p value will not occur before my own. My previous complaints

about other aspects of the **quality of abstracts** did not make any noticeable difference this year. Forty-eight began or ended with "Do not insert authors here." Subheadings (Methods, Results, Conclusions) still need to be in bold or upper case to make the abstracts easier to skim read; two-column format would also be a big help. I noticed several abstracts of the results-will-be-presented variety, but the executive director of ECSS told me that next year these are likely either to be rejected or to end up as e-posters only, not podium or mini-oral presentations. Authors, you have been warned! And finally, my usual entreaty: please avoid all those silly abbreviations that you mistakenly think make your work look more scientific; all they do is make your work harder to read, sometimes to the point where readers like me give up.

Accessing Abstracts and Videos

ECSS has again generously made the **conference abstracts** available via a search form on the Scientific Program page. Use the form to find abstracts with keywords from your field of interest. Use the form also to find the abstracts I refer to in this report, by pasting in the author's name and initial shown in brackets […] as the search term. This search form will stop working around mid-September, the start of the promotion campaign of the next congress. After that you will need to log in as a member of ECSS to access individual abstracts via EDSS, the European Database of Sport Science. PDFs of posters will also be available from then on as a link in the database–a big advantage of presenting your work as a poster. I keep asking for and hoping that the Powerpoints of the podium presentations will also be available in future.

ECSS has also made the **plenary sessions** and a **nutrition symposium** available on high-quality video at the ECSS.tv page, free to everyone on this link until July 26. One or two of the plenary presentations were a bit low on useful content. If the speaker hasn't engaged your interest with relevant data, information or ideas in the first few minutes of the video, I suggest you move on to the next one. After July 26 you will have to be a member of ECSS to view the videos. If you are not already a member, join now: the annual fee is a bargain, especially for students. Find out more on the ECSS membership page.

Although the focus of this conference report is again **athletic performance**, ECSS is much, much more. I have therefore added a section this year on **non-athletic populations**, in which I critique Claude Bouchard's plenary and tabulate some sessions. I'm sorry I can't provide a more detailed summary–as it is, this report took me literally a full week to write. Next year I hope to find a coauthor to help broaden the scope of this report.

Non-Athletic Populations

In the first plenary session, Claude Bouchard summarized the bad news that a program of extra **exercise** produces **"adverse" changes** in markers of cardiovascular and metabolic health (fasting insulin, HDL cholesterol, triglycerides, systolic blood pressure) in some sedentary individuals: 31% experience at least one adverse change, 6% experience two, and 1% experience three or four. Genes, of course, are responsible, and it will soon be possible to use genotyping to predict who will respond negatively and positively: there were strong relationships between the response to training and either the genes expressed at rest (in muscle RNA, the "transcriptome") or the differences in genes (single-nucleotide polymorphisms, "SNiPs") [Bouchard, C; see video].

Bouchard's definition of an adverse response as more than two standard deviations of technical error in the marker is misleading, if not wrong; what matters is a clinically important change, not a clear measurable change. If the clinically important change is larger than the measurable change, the proportion of adverse responders will be lower than Bouchard and colleagues have estimated. He also did not mention that a difference in a marker that predicts a clinically important difference in disease outcome in population studies (the only way at present to estimate a clinically important difference in a marker) is not necessarily the same as a clinically important change in a training study. In short, exercise might still be good for the individual whose markers change apparently for the worse. It would be ethically and logistically impossible to address this problem with a controlled trial, but it should be a straightforward matter to see how the genome modifies the relationship between habitual physical activity and health in long-term prospective cohort studies.

Here is a guide on how to find other presentations on non-athletic populations. Download the

PDF of the final program and either scroll through the sessions page-by-page, or advanced-find (Shift-Ctrl-F) a keyword like *metabolic syndrome*, or Find (Ctrl-F) the session code I identify below. (I was unable to include many session codes, because the topics were too diverse. Also, I could not list the posters that weren't debated, owing to ambiguity in the coding; scroll through these at the end of the program.) When you see a presentation that looks interesting, find the abstract (and the poster PDF for poster presentations) using the author's name and initial in the search form at the Scientific Program page, as described above.

- Adapted: OP-PM02, IS-BN09, OP-PM03, PP-PM01
- Ageing: IS-PM01, IS-SH11, OP-PM08, PP-PM07, PP-PM09
- Children: IS-SH10, PP-PM11
- Dance: PS-PL03-2 (video), IS-SH07
- General health/fitness: OP-PM42, OP-PM09, OP-PM33, PP-PM16, PP-PM17, PP-PM13, PP-PM19, PP-PM14
- Obesity: OP-PM07, IS-PM05, PP-PM10
- Patients: PS-PLO4-1 (video), IS-OM13, PP-PM63, PP-PM55, PP-PM56
- Physical education: IS-SH05, OP-SH04, OP-SH02, OP-SH03, PP-SH03, PP-SH04, PP-SH05, PP-SH06, PP-SH07
- Rehabilitation: PS-PL04, OP-PM38, OP-PM39, PP-PM54, PP-PM52
- Sport participation: PS-PLO2-2 (video), IS-SH01
- and many other topics–you search for *coaching*, *management*, *sociology* or whatever!

Acute Effects

Should **soccer** players **re-warm up** at half time? Apparently–it was only 8 players and the game was simulated with lab exercises, but in this crossover, a 3-min small-sided game or a 5RM leg-press performed at half time produced various enhancements of test performance compared with no re-warmup. The effects were clear but magnitudes weren't stated. [Zois, J]

The design is a bit unclear, but it looks like **warm-up** with really heavy loads enhanced running speed in this study of 10 high-level **sprinters**, presumably via **post-activation potentiation** [Gonzalez Hernandez, J]. In another example of PAP, enhancement of a **counter-movement jump** was greater with an isometric conditioning contraction (3.0%) than with eccentric (1.5%) and concentric (0.6%) contractions when performance was averaged (?) over the 20 min following the conditioning exercise in this crossover with 14 **athletes** [Tsoukos A]. For those of us interested in the mechanism, a 6-s maximum voluntary contraction potentiated peak torque in six **power athletes** by up to 17% in the subsequent 3 min, but Achilles tendon stiffness was not affected [Gago, P].

Fifteen junior elite **ice-hockey players** performed sprints faster by 2.2%, 1.0% and 2.6% over 10, 20 and 40 m when 30 s of half squats in the warm-up were performed with **whole-body vibration** (presumably on a platform) [Slettaløkken, G].

In **ischemic preconditioning**, a sphygmo cuff is inflated to cut off blood flow to the legs several times each of a few minutes before the athlete does some kind of high-intensity performance. Mean power in a 4-km time trial on a cycle ergometer was 2.2% higher following ischemic preconditioning in a crossover with eight **cyclists** [Kilding, A], but a similar treatment impaired 5000-m time-trial time in the field by 7.6% compared with sham or reference condition in a crossover of 11 well-trained **runners** [Crisafulli, A]. It also had apparently negligible benefit on 30-m sprints in a crossover study of 25 **team-sport athletes** [Gibson, N]. Hmmm… needs a good meta-regression type of meta-analysis.

When a **cyclist** rides in a more **upright position**, metabolic efficiency is improved but wind resistance increases. "This study showed it is beneficial to ride in a more upright position when velocities are below 30 km/h" [Fintelman, D]. When drafting behind other riders, the threshold speed is presumably higher.

Under hot environmental conditions, thermoregulation was improved when six well-trained **endurance athletes** wore a **synthetic shirt** vs a cotton shirt. Performance was "unaffected". but the study was obviously underpowered and the only data shown in the abstract were p values. Time to exhaustion in the poster appears to show a small but substantial benefit with the synthetic shirt [Born, D].

A combination of **cold-water immersion**, full-body **compression garments** and better **sleep** following **tennis** drills and match-play resulted in better **recovery** and performance the next day in comparison with usual recovery in

this crossover study of eight male high-performance tennis players [Duffield, R].

Transcranial electrical stimulation for recovery? A 20-min session following a competition produced substantial changes in heart-rate variability consistent with better **recovery** in this study of 10 **powerlifters**, although the exact design is unclear [Roguleva, L].

Electrical stimulation of muscles with the Veinoplus Sport to increase blood flow after a Wingate test on a cycle ergometer likely enhanced performance of a subsequent Wingate compared with passive **recovery** and sham stimulation in this parallel-groups trial with 37 well-trained **cyclists**. The poster shows clear moderate-large effects [Bieuzen, F].

Titanium-impregnated garments worn by 10 **healthy men** during recovery from strenuous exercise "improved subsequent **running** economy to a magnitude likely to restore endurance performance" [Rowlands, D]. In the absence of any plausible mechanism, it has to be a Type 1 error.

Stretching might work sometimes after all. Static stretching of 10- to 20-s duration at the end of a warm-up enhanced subsequent 10- and 20-m **sprint running** performance, and longer static stretches had little effect in a crossover study of 20 young adult athletes [Chatzinikolaou, A]. A 30-s **static stretch** followed by three sets of five tuck jumps produced more flexibility and jump height than a 15-s static stretch and one set of the tuck jumps in 14 **artistic** and 10 **rhythmic gymnasts** [Donti, O]. But static stretching and PNF (proprioceptive neuromuscular facilitation) both impaired front-crawl **swimming** performance compared with no stretching in 13 young males [Fernandes, R].

Dorsiflexion shoes did not produce improvements in peak power or jump performance in 35 **active participants**, and they were less comfortable than conventional shoes [González-Millán, C].

The main finding in a study of **timeouts** in **basketball** is that coaches should make their tactical instructions more meaningful by drawing instructions on a board from the players' perspective, or at least "turn the tactic board towards the players before they finish the timeout." [Schul, K]

Injury

In a prospective study of 50 elite male **team-sport** players, **reaction time and accuracy** at the start of a season were slower and lower by a small-moderate amount in players who subsequently experienced overuse or acute knee injuries [Dallinga, J]. The effects should have been presented as increased risk, which my guess would be at least 50%. I can't see how this risk can be mitigated.

"Match **injury incidence** rates in professional **rugby union** can be considered high in comparison to other team sports but similar to other collision sports" [Williams, S]. **Injury incidence** rate for female rugby players was less than half that of males in premiership matches but similar to that of males in international matches, yet the women were out of play for three times longer than the men [Gabb, N]. Both abstracts concluded with a recommendation to target injury-prevention strategies for the lower limb. And from a study of community-level rugby union, "injury prevention strategies should focus on player education around the tackle event and exercises which strengthen the muscles in the shoulder, knee and ankle" [Roberts, S].

A kinanthropometric measure indicated *increased* risk of ACL injury following four months of the "11+" **injury-prevention program** with 16 adolescent female **soccer** players. But there was no control group, so the authors argued that the risk was increasing anyway and that maybe the 11+ reduced the increase [Saho, Y]. Well, who knows? Conclusion: you need a control group or a long baseline.

Nutrition

In a presentation on the **low-high carbohydrate** debate (train on low carb, compete on high carb), Asker Jeukendrup first reminded us that supplementing with a mix of glucose and fructose in the event itself results in better performance than supplementing with glucose or glucose polymers, although he did not mention the gut problems many athletes experience with fructose in longer endurance events. He then presented results from various studies showing that training on a low-carb high-fat diet leads to changes in muscle biochemistry that ought to benefit performance, but performance itself is better with training on high carb, at least for events of up to several hours' duration [Jeukendrup, A; see video]. There are anecdotal reports of ultra-endurance athletes switching successfully to low-carb diets (example: Tom Olson), but now we need studies, especially

with attention to the issue of individual differences.

Two of the three speakers in a symposium on **antioxidants** reviewed the studies showing harmful effects of vitamin C and E supplements on training [Gratas-Delamarche, A; Gomez-Cabrera, M; see videos]. The third speaker, Zsolt Radak, left room for beneficial effects of antioxidants by suggesting that the hormesis theory of the effects of toxins may apply to free radical species: "low doses stimulate, high doses inhibit". It follows that supplementation with antioxidants "on the malfunctional side" of the hormesis curve (hard training) could be beneficial [Radak, Z; see video]. Most of the studies presented by Zsolt involved the antioxidants vitamin C, vitamin E, or resveratrol (in doses you can't get from drinking red wine) with rats and mice. What we need now is studies in athletes of supplementation with berries and cherries or their polyphenol antioxidants.

Consumed acutely, antioxidants are generally beneficial to performance and recovery. In a randomized controlled trial of 10+10 **recreational runners**, **tart cherry juice** consumed before, during and after a **marathon** reduced concentrations of markers of inflammation (interleukin-6 and C-reactive peptide) and reduced the incidence and severity of upper respiratory tract symptoms, presumably via polyphenols [Dimitriou, L].

N-acetylcysteine (**NAC**) is a particularly powerful **antioxidant** that has been shown to enhance endurance performance when administered acutely in most previous studies. Here in a comprehensive study of 40 **football players** randomized to one of four treatment groups, it was indeed beneficial for performance in the first of a series of three matches over a period of one week, and it speeded up recovery between matches [Fatouros, I]. But it *impaired* mean power in a 10-min time trial by 4.9% in a crossover study of 9 well-trained male **cyclists** [Trewin, A]. Sigh… more studies needed.

Consumption of **green tea** has been reported to increase **fat oxidation** during exercise in some studies, but in this reasonably powerful crossover study of 19 lean **males**, there were no significant changes in fat oxidation rates or blood markers related to fat metabolism following a single bolus and following 7 and 28 days of supplementation [Randell, R].

Supplementing with **nitrate** *impaired* 5000-m **treadmill** performance time-trial time by 1.1% in a crossover with nine highly trained **cross-country skiers**. Addition of L-arginine to further boost availability of nitric oxide reduced the impairment slightly, and neither treatment had any substantial effect on 200-m time-trial time [Bucher Sandbakk, S]. On the other hand, power output in a 25-min **cycle** test improved by 1.7% while time in a 5-km run improved by 0.8% when 11 **triathletes** supplemented with **beetroot juice** (vs nitrate-free beetroot juice) [Leckie, T]. Taken together with other evidence, it seems likely that the more highly trained the athlete, the less beneficial the nitrate. Actual harm is not out of the question, because the generalized vasodilatation caused by the nitrate that is responsible for an observed drop in blood pressure could divert cardiac output from the active muscles. In my view, top athletes should not take beetroot juice or other nitrate supplements in general until these effects are clarified.

Oh dear, and yet another iconic effect goes away! Far from enhancing performance, **carbohydrate mouth rinsing** compared with placebo impaired 1-h time-trial time by 1.5% and 2.0% in fasted and fed states respectively in this multiple crossover study of 16 trained male **cyclists** by a high-profile research group [Trommelen, J]. Note that these effects are on time; effects on mean power would be at least twice as much. So where is the Type 1 error, here or in the earlier research? Call me skeptical, but I suspect mouth rinsing simply doesn't work. One of our master's students is having trouble showing anything with it.

Certainly, *swallowing* carbohydrate makes a difference. Here "a low glycemic-index **breakfast** appears to support better **cognitive function**" in a crossover with 16 athletic **adult males**, which is consistent with research on other age groups [Wu, D].

Thank goodness **caffeine** is still working, too! It possibly gained rather than lost potency on a second day of administration: the eight highly trained **cross-country skiers** improved their performance in a 10-min skiing ergometer test by a massive 4% on the first day and by an even more massive 5% on the second day when they consumed either of two doses of caffeine compared with placebo in crossover fashion [Stadheim, H]. In a crossover of four trials, 11 resistance-trained **men** showed a tendency to

improvement (in the poster) in **explosive power** against a range of loads following a 6 mg/kg dose of **caffeine** ingested in the afternoon, and the 5-9% reduction in performance that occurred in the morning was eliminated by caffeine. Power in a 4-s **cycling sprint** was apparently unaffected (no data shown in abstract or poster) [Mora-Rodriguez, R].

And **beta-alanine** supplementation is still working, this time on explosive strength (4% relative to control) and high-intensity power (7%) in a small sample of 11 male junior **alpine skiers** randomized to one or other treatment for 5 wk of training [Vogt, M].

Wow, it's amazing that it hasn't been investigated before, so even though the nine male subjects were only **recreational cyclists**, it's still worth knowing that three 500-mg tablets of **acetaminophen** (**paracetamol**) enhanced mean power in a series of eight Wingates (30-s all-out sprints) by a staggering 8.2% compared with placebo! The improvement came mainly in the last three sprints [Foster, J]. The same group showed that time to exhaustion of 10 **active males** at constant power output in a **cycling** test lasting ~15 min in the heat also increased by 21% with paracetamol, which is equivalent to about 1.5% in a time trial. A reduction in core temperature appears to have been involved, along with analgesia, presumably [Mauger, A].

It looks like **oral contraceptives** have a small anabolic effect. In this parallel-groups **strength-training** study of 14+14 **young women** who had not participated in strength training in the previous six months, those using oral contraceptives gained a little more muscle mass than those who weren't, but there was apparently little difference between the strength gains [Hansen, M].

Performance Analysis

Mixed linear modeling is a powerful tool to adjust for and estimate effects of **environmental factors** on competition performance [Hopkins, W; download the slideshow via the In-brief item in this issue of Sportscience]. The approach has been applied to develop career performance trajectories of elite **triathletes**, which will be useful for **talent identification** and development [Malcata, R].

A principal-components analysis of 51 dimensions of movement data was able to distinguish between fake and true **passes** in an unstated number of university **basketball** players performing an unstated number of passes. "The distinct slow-down of movements of the upper limbs was differentiated from the general forward motion of the majority of the body segments in the deceptive passes" [Peng, S].

A Spanish group has devised a reliable observational instrument for assessing "48 categories organized in seven criteria" of **decision-making** and **motor intelligence** in **basketball** [Serna, J]. No details were provided in the abstract or the poster.

There were some fairly obvious relationships between usual **performance indicators** (possessions, meters gained, line breaks and so on, analyzed from videos) in a season of **Super rugby** and the final ranking of the teams [Marmar, N].

Analysis of **performance indicators** of winning and losing teams in the under-17 **soccer** world cup was limited by the sample size (only 10 games), but the findings might be useful [Fritzler, W].

The **relative positions** of **soccer** teams change with pitch size and small-sided vs full-size matches, but you had to be at the presentation to hear "suggestions for future research and clear practical implications for coaches and sports scientists" [Frencken W]. Unfortunately I had to attend a different session.

The reproducibility of most **performance measures** in 11 highly trained youth **soccer** players playing two small-sided soccer games two months apart was poor (typical errors >100% and retest correlations <0.2), which limits their utility for tracking changes in individuals [Mayer, N].

Differences in **body position** between faster and slower **speed skaters** in the last laps of a race presumably arise from differences in fatigue [Stoter, I].

I thought I was about to discover the **temporal patterns** of play by AC Milan in the most recent national league **soccer** championships, but after the description of the methods, all I found was "Data analysis ongoing work"! [Anguera, M]. This abstract obviously slipped past the reviewers. The poster was blank!

It gets a bit technical, but this analysis of factors affecting **inter-limb coordination** in **swimming** will be useful to those in the know [Seifert, L].

Tests, Technology and Monitoring

Tracking changes in the **transcriptome**–the

messenger RNA of active genes–represents the ultimate mechanisms analysis for training and nutritional interventions. Several very impressive studies were presented [e.g., Rowlands, D; search for *gene expression* to find the others]. I was initially enthusiastic about the potential of the transcriptome for identifying how something like altitude training works and for explaining individual responses to interventions, but now I am more skeptical, for three reasons. First, you need a series of muscle biopsies, which is too invasive for some athletes. Secondly, there are dozens of suites of genes represented in the transcriptome, and there are bound to be substantial individual differences between athletes in the contribution of some suites, so sample sizes will need to be larger than the usual handful to constrain inflation of the rate of erroneous associations with performance. Finally, I can't see how the technique can be applied to enhance performance of the individual athlete. Sure, the sport scientist ends up with "novel insights" that get into high-impact academic journals, but all the athlete is left with is a sore thigh. Identifying individual responders by genotyping a mouth scraping will be a more practical approach to identifying responders. That said, I have to agree with Dave Rowlands' response to my skepticism: "sure, we can quantify effects on performance without the biopsies and biochemistry, but understanding the mechanisms leads to more informed speculation about new strategies."

The Accrow is a new **accelerometer** with software that simplifies monitoring of boat movement and stroke kinetics in **rowing** [Schaffert, N].

Wow, some biomechanists have **instrumented** the paddle, seat and foot-bar of a **kayak** [Rosdahl, H]. It's unclear yet whether the signals can be combined to measure the paddler's power output with acceptable precision.

A novel linear **tribometer** has been developed to measure **frictional drag** on **cross-country skis** [Hasler, M]. The device has also been adapted to measure aerodynamic drag of materials (e.g., clothing) without the need for a wind tunnel [Schindelwig, K].

Skiing biomechanists will be interested in the interaction between **snow** and the latest skis and the resulting loads on elite **skiers** [Kröll, J].

Anyone trying to make sense of **heart-rate variability** with their athletes will find this study of 14 national-level **track-and-field athletes** interesting and possibly useful: the ratio of low-frequency to high-frequency power after an "orthostatic load" (not defined) decreased in a competition phase compared with a "recovery" phase (not defined), and therefore "adrenergic activation may reflect readiness for competition" [Schäfer, D]. Heart-rate variability at rest presumably showed nothing useful.

Talent Identification and Development

In an analysis of 15 countries since 2000, the most successful strategy for a country to get more **medalists** is to **spend more money**, but smart spending can also make a difference [De Bosscher, V].

One way to spend the money is on **sport for all**. But on the basis of a survey of 15 countries in 2011, "sport policies directed towards broadening the participation base are of only secondary importance in explaining differences in elite **sporting success** between nations, and such policies are most effective if they lead to more **organized sport participation**." [Dijk, B]

Don't just count Olympic medals! There are various better ways to assess the **sporting performance** of nations [Shibli, S].

There were several presentations relating **genotyping** to athleticism, but in the most comprehensive of them, there was no combination of polymorphisms in seven genes that would distinguish **endurance athletes** from non-athletes [Drozdovska, S]. Certain genes do make a difference to the effects of high-intensity training in moderately trained males [Bishop, D]. I can't see a specific application to athletes yet, but it's coming.

Semi-structured interviews of top-level coaches in **alpine skiing** (n=6) and **soccer** (n=8) revealed "large differences in the explicitness of the selection criteria and in coaches' beliefs about the importance of having and communicating criteria". It follows that the **selection process** has imperfect validity, so the wrong athletes are being selected frequently. Furthermore, "none of the coaches had any education concerning selections…, which further points to a need for research on selection processes." [Johansson, A]

For **triathletes** apparently "there is no association between **ranking** in junior world championships and the ranking in the senior elite level", so the German and any other system of selection based on performance at the junior

elite level needs revising [Wulff, J]. See also the presentation on career **performance trajectories** of triathletes [Malcata, R].

Training

Gershon Tenenbaum's plenary session on **psychomotor aspects** of athletic performance was in two halves. First he pointed out that visual attention and retrieval from memory are more efficient in experts, but apparently you will have to clock up the 10,000 hours to get the efficiency of the expert. He then presented his idea that being "in the zone" for maximum adaptability occurs when your perception of your ability to cope with a challenge is greater by some optimum amount than your perception of the difficulty of the challenge. But how do you measure this mismatch? There may be some physiological markers: the quiet-eye period, hemispheric asymmetry in the EEG, and even measures of heart rate and EMG. Will these ever be useful in practice? [Tenenbaum, G; see video]

Wow, **contextual interference** has been shown to enhance learning of motor skills, but here is the first study showing that it works with acquisition of a perceptual-cognitive skill, anticipation of shot direction in **tennis**. Eighteen players "were required to anticipate shot direction when viewing life-size video… of opponents playing tennis shots occluded at ball-racket contact…. One group practiced under low contextual interference in which the three types of tennis shot were practiced in separate blocks, whereas the other group practiced under high interference, in which the three shot types were practiced in a quasi-random order" for an unstated time. Subsequent performance in the lab was better in the high-interference group by a small-moderate amount, and there was some transfer to the tennis court [Broadbent, D].

Differential learning, in which variability in the task was increased without feedback, resulted in improvements in velocity of the overhead **badminton** smash, whereas more uniform drill training with feedback showed no positive learning effect [Jaitner, T].

Deliberate play (organized by kids themselves) was strikingly more effective than **deliberate practice** (organized by coaches) in this observational study of six boys of age 11-12 y playing **soccer** in local teams [Nybakken, T].

Twelve weeks of training based on "**sensory-perceptive exercises**" aimed at improving the dolphin underwater kick reduced the duration of the start phase by a valuable 1.0 s in this 12+12 parallel groups randomized (?) controlled trial of elite butterfly **swimmers** [Ciapparelli, C]. The exercises were not described in the abstract or poster.

With only four **golfers** in each of three groups, you have to interpret as at best *suggestive* the finding that **feedback** on the athlete's main **error** ("method of amplification of error") produced bigger improvement in the golf swing than either "traditional direct instruction" or no feedback [Milanese, C].

Wow, if injury or illness stops you from training, it's just possible that playing the right kind of **video games** could reduce loss of **skill**. That seems to be a reasonable extrapolation from this truly novel study, in which 14 male **older adults** were randomized to 14 d of bed-rest with 50 min a day of either "virtual maze navigation" or viewing the Discovery Channel. In a subsequent walking test the maze group had better gait [Marusic, U]. Hopefully we will see some studies on injured athletes at a future ECSS meeting.

Video seems to have been used successfully to train the spike in **volleyball** in this controlled trial of female under-16 players experiencing 30 training sessions, but I can't figure out exactly how the experimental and control groups differed in their use of video either in the abstract or the poster [Parisi, F].

The abstract of a 4-wk 14+14 controlled trial aimed at improving the accuracy of **free throws** in youth **basketball** with a structured approach (Amberry's) did not include baseline performance, but the poster showed the experimental group going from ~60% to 70% success pre to post, while the control group went from ~62% to only 63% [Kreivyte, R].

Training with a **medicine ball** rather than the usual handball produced a 14% vs a 4% increase in throwing speed in this randomized controlled trial of 28 4th-division female **handball** players, apparently with little (but unreported) effect on precision [Raeder, C].

The second speaker in a symposium on specificity of **strength training** in elite sport presented the following strategies to reduce **interference** of strength and endurance training: short (5-wk) training phases; no concurrent training for hypertrophy (8-10RM) and aerobic power; strength sessions at least 8 h before

endurance sessions; and no repetitions to failure [Izquierdo, M]. The third speaker emphasized that training to failure was not optimal for elite athletes: "no pain, more gain!" [Gorostiaga, E].

"An 18-wk program of bi-weekly **heavy resistance** and **high-intensity exercises**" added to usual in-water training in this randomized controlled trial of 11+16 elite male **water polo** players resulted in substantial gains in swimming speed and various measures of fitness relevant to these athletes [Ramos Veliz, R]. A similar study of 10+11 elite female players by the same authors gave similar results, although apparently not for swimming speed.

Addition of **heavy strength training** consisting of four lower-body exercises each 3x 4-10RM for 10 wk to their usual endurance cycling training resulted in improvements of 3-5% in measures of sprint and endurance power in this controlled trial of 10+10 high-level male **cyclists** [Rønnestad, B]. Researchers from the same lab got even bigger gains in a similar study of female cyclists [Vikmoen, O].

It seems amazing to me that the researchers went to all the trouble to allocate 134 youth **soccer** players to usual training vs usual plus **strength training** consisting of once weekly front and back squats for two years, yet all they measured were changes in 1RM strength ("up to" 65% vs 300%) and in sprint speed (3% vs 6%) [Sander, A]. I guess it would be hard to determine whether the extra strength training improved performance in games. Whatever, it seems to have been worth it.

Replacing one of two weekly repeated-sprint sessions with **strength training** produced small-moderate extra gains in repeated-sprint ability and lower body strength in a controlled trial of 8+8 professional **rugby** players [Suarez-Arrones, L].

Ever heard of the **hypopresive method** of training? I checked out the website to discover that it's a method of **core training** involving "postures that reduce intra-abdominal pressure and stimulate a reflex contraction of the pelvic floor and core muscles". Apparently I can use it to get "less pelvic congestion and more pelvic blood circulation and thus better sexual function", amongst much else. I guess we should therefore be skeptical about claims for its benefits with **swimmers** [Riera, T].

A 6-wk **individualized training** program based on Coggan's measures of **cycle** training produced substantial gains in various measures of performance in a controlled trial of 14 middle-aged **triathletes** [Fernández-Montilla, J].

Apparently there were "no interactions" (and no data shown) for effects of **high-intensity intermittent training** on various cycle ergometers vs running in the field vs control (technique training, which all three groups received) in a controlled trial of 25 male **soccer** players [Takimoto, M]. But the poster itself shows substantial effects on VO2max and Yo-yo (repeated-sprint) performance in the two HIT groups compared with control.

Low-load **resistance training** for 5 wk combined with either **vascular occlusion (Kaatsu training)** or breathing **hypoxic air** resulted in greater increases in strength and muscle cross-sectional area than control training, differences that may have been due to transient differences in changes in growth hormone concentration after the training sessions in this controlled trial of 10+10+10 **team-sport athletes** [Hamlin, M].

Wow, there was a really clear effect of **intermittent hypoxic training** in this controlled trial with 10+11 **Aussie-rules** (AFL) **footballers**. The hypoxic group performed 11 40-min sessions over 4 wk at 2500 m simulated altitude, each session consisting of three to four 5-min cycling intervals separated by 2.5 min. Yo-yo test performance increased by 15% more than control after just one week, by 28% after two weeks, and was maintained thereafter. These effects were small-moderate in standardized units, an appropriate metric for team-sport athletes [Aughey, R]. Sixteen female **ball-game players** similarly got more gains in repeated sprint but not endurance (VO2max) performance when they performed two sessions per week of 10× 7 s of maximal pedaling (with 30 s rest between sets) in normobaric hypoxia (14.5% oxygen) compared with 16 in a control group who performed equivalent training in normoxia [Kasai, N].

And the final wow… The abstract is of the results-will-be-presented variety, and I missed the presentation itself, but Ferran Rodríguez very kindly ran me through the results of this heroic study of three kinds of real **altitude training** involving 65 elite **swimmers** from eight nations. In summary, live-high train-high, live-high train-low and live-low train-low (the control) ended up with similar mean performance improvements of ~3-4% in swim time

by 3-4 wk after four weeks of exposure, whereas live-high train-high-and-low gained a clear 2-3% more. There was no evidence that increases in hemoglobin mass were responsible for the gains in any group. Ferran was confident that any differences in changes in training between the groups (who had their own coaches throughout) did not explain the superiority of live-high train-high-and-low. Anecdotally the swimmers had a better feel for the water in this group, so he favors improvement in economy at maximal intensity, which is practically unmeasureable. Unfortunately there was no tendency for submaximal economy to be better [Rodríguez, F]. Maybe the transcriptome would sort out the mechanism, but I suspect it will be unclear. Ferran feels obliged to report the outcomes using p values, because the difference between the live high train-high-low and other groups was statistically significant, so he can expect to get the study into the Journal of Applied Physiology if he plays their hypothesis-testing game. This strategy was pioneered by John Hawley over a decade ago: "if $p<0.05$, publish; if $p>0.05$, call Will".

See you "around the canals" next July 2-5 at the ECSS conference in Amsterdam!

Reviewer's Comments

Martin Buchheit, the reviewer of this report, was less enthusiastic about the success of the conference. We agreed that I should list his concerns here and address them pointwise, for the benefit of other attendees who may have felt the same way, and for such action as future conference organizers deem appropriate.

- *There are problems with the poster (mini-oral) format. You could not see what was on the screen, and if you were in one session you could not see the posters in the other 20 sessions. There was no chance to meet the researchers as with the old fashioned paper posters. I realize there were problems with the old paper posters, and we're unlikely to see them again, so what can ECSS do to improve the e-poster sessions?*

I thought the posters were quite successful. Here's why, and some suggestions for ways to make them even more successful next year.

Yes, you couldn't see what was on the screen, but it was a big improvement for everyone to hear what the presenter was saying. Also, every session had a technical support person who could easily have magnified a key table or figure on the poster so that everyone could see it. Thomas Delaveaux of ECCS has told me that the plan next year is for presenters to show effectively a slide each for methods, results and conclusions in this manner. In any case, the real value of the poster comes *after* the conference, when we can view the details of the methods and results.

With paper posters a substantial proportion of presenters got no interest whatsoever from attendees. Now each presenter is guaranteed 4 min of attention from a reasonable audience. That's got to be a plus.

You can talk to the presenter or arrange a meeting after the session, but only if you are able to attend their session. So maybe we need some kind of "dating" service to bring attendees into contact with poster presenters or any other attendee, in the lunch-hour or some other assigned period every day. If it hasn't already been done, someone should write a program and an app that would optimize a daily schedule of encounters at locations (signposted around the exhibition hall alphabetically by the person you want to meet) and times (5-min slots). You would register your interest in meeting whoever, and you'd both get back a mini-calendar showing who, where and when.

Previously you could view posters only for a few hours, whereas now you can view e-posters before, during and after the meeting (eventually, in September). Realistically there would have been very little viewing before or at the meeting, so ECSS needs to make the poster PDFs available *now*, while there is the interest generated by the meeting itself and by this report. September is already too late.

I think it is even more important to make the podium Powerpoints available on line. I had to miss many interesting podium sessions, because I was either presenting my own work, or attending my students' or colleagues' presentations, or attending another session that clashed. Why can't I see their slides? They are all on a server somewhere, and there are far fewer of them than of posters to link into the database.

- *There were not enough "applied" topics for me, by which I mean projects with real athletes in real life. There were too many controlled studies, not enough "on the fly" with elite athletes, if you see what I mean. With good stats you can control for confounders*

and get the best out of the data.

The topics presented are those submitted by attendees. The conference committee would not have rejected studies of competitive athletes. Is it possible that sport scientists who work with athletes are submitting their abstracts to other conferences? If so, ECSS needs to attract them back to future conferences. ECSS has made a step in the right direction by giving more recognition to research on athletes for the young-investigator awards.

- *For many presentations I wanted to ask: why did you do this study? They just seemed pointless to me.*

All conferences have the problem that most attendees get funded only if they present something. I have always asserted that most published research has little or no real novelty, and at conferences maybe 95% of presentations have no useful content. And yet they *are* useful, not only in getting the researcher to the conference, but more importantly in developing the researcher's skills in design, analysis, interpretation and presentation.

- *I saw very few good talks. Most of the students need to improve their skills to present their slides in 10 min, and their English was often hard to understand.*

This problem is generic, not one that ECSS can address beyond continuing to provide guidelines and educational programs. Actually many experienced presenters showed bad slides. The main problem is tiny fonts, often in published graphs and tables that they have simply pasted into the slide.

- *With few exceptions, the same big-name speakers were saying the same things they have already said at every other conference they've been invited to. If you'd read their papers, you wasted your time. We need some changes and novelty to get excited. The symposium on specificity in strength training in elite sport is an example of good speakers presenting cutting edge research including* unpublished *findings. "No pain MORE gain" is new and awesome. Everyone got something from it, which was rare this year.*

Yes, there were a few outstanding speakers and a few who had nothing new to say, but aren't all conferences like that? Even so, the conference committee should strive to have invited symposia and plenary sessions presented by experts who are still producing highly-cited original research. The committee could also consider having fewer plenaries of higher quality, and to use the freed-up program time more successfully.

I thought the level of novelty was higher than at previous conferences. In the past I have said that a single really original finding makes a conference worth attending. Here there were half a dozen, and look at all the other interesting stuff in my report. There's no problem, once you accept that 95% of the presentations at any conference are valuable only for the presenters!

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