

## The Best-Yet Annual Meeting of the European College of Sport Science

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Amsterdam was the venue for this annual top conference on sport science. [Accessing Videos, PDFs and Abstracts](#): links to downloads. [Best of the Best](#): our picks for enhancing performance. [Acute Effects](#): pacing; ischemic preconditioning; warm-up; post-activation potentiation; pre-cooling; electromyostimulation; cryotherapy; arousal; hurdler's run-up; stretching; [Injury](#): core stability; injury-prevention warm-up; running shoes; strategies for ankles. [Nutrition](#): carbohydrate sleep low; nitrate; whey protein; beta-alanine; caffeine; vitamin D. [Performance Analysis](#): soccer tactics; eye movements; skier variability; baseball pitching; skier strength. [Tests, Technology and Monitoring](#): heart-rate variability; heart-rate recovery; perceptual measures; auditory feedback; real-time tracking; skiing biomechanics; minimalist shoes; mountain-bike wheels. [Talent Identification](#): swimmers. [Training](#): mental fatigue; heat and cold adaptation; concurrent strength and endurance; resistance; speed; interval; downhill; overload; visual-control; quiet-eye; cryotherapy; core; muscle cramp. KEYWORDS: competition, elite athletes, ergogenic aids, nutrition, performance, talent identification, tests, training.

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One of the reasons for attending the ECCS conference every year is the pleasure of a few days in a unique and wonderful European city or resort. The 2014 conference in Amsterdam July 2-5 was no exception. One of us stayed in a friendly budget hotel close to the center of town, hired a classic Amsterdam black bike and rode the 20 min along the picturesque canals and parkways to the conference center on the outskirts. The other stayed in a central apartment and took the tram each day. The opening ceremony featured a mystifying modern dance that was totally eclipsed by a talented team of three who juggled implements and words with unbelievable dexterity. The closing ceremony celebrating the [young investigators](#) gave one of us warm fuzzies and the other a prize of €2000 (and an entertaining but strangely cocktail-less cocktail party). The really interesting and successful venue for the conference dinner was a quirky old science museum, the Nemo (as in 20,000 Leagues Under the Sea), and a high point before the flight home the next day was the touristy but inspirational Van Gogh museum.

Check out the statistics and logistics in the [official debrief](#), and view a [conference collage video](#) on the ECSS YouTube channel. Congratulations once again to the ECSS conference team and to the local organizers: Arnold de Haan, Willem van Mechelen, Peter Beek, and their team of volunteers. As usual, the bar is set even higher for the organizers of the [next ECSS conference](#), in Malmö, Sweden.

For the first time this year there is a [separate ECSS conference report](#) on all the aspects of exercise science and medicine not directly related to athletes. Our report summarizes the presentations of research relevant to performance and injury of competitive athletes. This conference was probably the best yet for quantity and quality thereof. Yes, there was the usual high proportion of presentations that were of value only to the presenter, but as noted in [last year's report](#), such presentations are part of any conference. Maybe there are too many masters and PhD students doing too many seemingly pointless projects, but if their projects teach them about research and get them to a conference as good as ECSS, then it's all worthwhile.

Accommodating the presentations of all those projects is an ongoing challenge for conference organizers. ECSS has risen to the challenge with a unique tiered structure of presentations, starting at the highest level with plenary sessions (lasting  $2 \times \sim 30+5$  min) and invited symposia ( $3 \times 20+10$  min). The next level is original research presented at the podium (up to  $6 \times 10+5$  min). Then there are the chaired mini-oral sessions, where each speaker presents only four slides (up to  $12 \times 2+2$  min). Finally there are the e-posters, available for viewing throughout the conference without formal in-person presentation.

The structure works really well. The plenaries, symposia and original podium presentations are conference standards. The mini-orals are a good compromise to give as many researchers as possible the opportunity to present their work in a chaired setting. (Most presenters take their 2+2 min very seriously.) At the moment e-posters are the Cinderellas, yet they have the potential to be the best medium for conference interaction. Some kind of dating software could be used to bring presenters and delegates into personal contact. We imagine an app that provides a key-word search of e-posters, mini-orals or podium presentations, and from the hits you text or email the lead author directly via the conference wifi. For example: "Meet u at eposters to talk?" "Ok today 13:30? Red hair. Glasses." "Cool. Bald. Green jeans." Or a different conference app could allow e-poster or other presenters to choose a 10-min slot in a lunch hour or a plenary unrelated to their interests. The chosen time would appear in the hit when delegates do key-word searches of the e-posters or mini-orals or searches of author names.

#### Accessing Videos, PDFs and Abstracts

The [conference site](#) has program pages for each tier of presentation or a [PDF of the full program](#), all accessible via the [scientific program page](#). Videos of plenaries and some invited symposia can be accessed via the [ECSS.tv page](#) via the [login page](#) for ECSS members only. Members can also access all abstracts, mini-oral slides and e-posters via the [Amsterdam search form](#) or the [EDSS database](#). To find the presentations we have reviewed, copy the presenter's name and initial or the session code shown in brackets [...] into the search form at the ECSS site or into the advanced search form

in the Adobe Acrobat PDF reader.

All 896 podium original ("oral") presentations and 73 of the 114 invited symposium presentations had no downloadable content other than their abstracts, yet the 488 e-posters and the slides for all 410 mini-orals were available as PDFs. Please, ECSS, can we have PDF downloads of slides for all presentations in future?

#### Best of the Best

Here is our pick of the most exciting or innovative original research (in their order in the report): [stretch to improve](#) explosive power; [delay carbohydrate replenishment](#) by "sleeping low"; [monitor heart-rate variability](#) after a sub-maximal test; put [bigger wheels](#) on your mountain bike; [add mentally fatiguing tasks](#) to training sessions; and [stimulate muscles](#) to prevent cramp (maybe). And the best plenaries and symposia: [core stability](#), [tactics in soccer](#), and [concurrent strength and endurance training](#).

#### Acute Effects

A symposium on **pacing** in **endurance** events was delivered by three entertaining experts: Ross Tucker, Carl Foster and Bart Roelands. They explained how the perception of effort is used to anticipate the demands of a race and thereby to set a near-optimal pace matching available resources to the demands. The coupling between perception of effort and pacing develops around age 10 in children and requires familiarization trials at any age (although the speakers did not make enough of this point, and it seems to be under-researched). Various drugs acting on the central nervous system can uncouple effort and pace, usually resulting in impaired performance, but the dopamine reuptake inhibitor Ritalin enhances endurance performance in the heat apparently by allowing the subjects (trained men) to reach a higher core temperature at the point of fatigue. In response to a question about the lack of any mention of Tim Noakes's "governor" in the symposium, Ross Tucker explained that the concept had undergone substantial changes over the years, and that it was better to avoid confusion by finding other ways to talk about the integration of sensory inputs and control of motor outputs by the central nervous system (not necessarily his exact words). [IS-PM04; alas, no video]

**Ischemic preconditioning** as a warm-up

strategy appears to improve performance in activities with a substantial aerobic contribution, but how best to apply this strategy? In her contribution to a symposium, Helen Jones suggested restricting blood flow ~20 min before exercise to the lower limbs is generally effective. Current uncertainties include the optimal number and timing of cycles of blood-flow restriction and reperfusion [Jones, H]. In a mini-oral presentation, ischemic preconditioning of the lower limbs enhanced mean (?) power in repeated sprints by 2.3% in a crossover with 14 males recreationally active in various **repeated-sprint sports**. [Patterson, S]

Be careful not to **warm up** for too long. An 8-min active warm-up produced a 4% greater peak power output in a 30-s sprint than a 17-min active warm-up in nine **cyclists**, although differences in mean power output were trivial. [Farrell, J]

Performance in a 20-km cycling time-trial in the heat was ~2.5% faster with ad libitum **ice-slurry** ingestion during exercise than with **pre-cooling** as well or in the control (neither intervention) in seven male **triathletes**, therefore (paraphrasing the authors) it's better not to feel too cold before performance in the heat? [Schulze, E]

Low frequency **electromyostimulation** while wearing a **cooling vest** during a 75-min recovery period between two 1-km time-trials in the heat led to better maintenance of performance (by ~2%) in the second race compared with active recovery while wearing the vest in a crossover with eight elite **kayakers**. Active recovery apparently contributed to "thermoregulatory strain" [Borne, R].

Athletes might perform motor tasks more effectively under pressure if they are told to treat the sense of pressure or **arousal** as a natural response and a challenge rather than a threat. This strategy improved **golf putting** performance in a controlled trial with 50 "participants", anyway. [Moore, L]

An elite male **hurdler** who took a seven-step **run-up** to the first hurdle instead of the usual eight performed worse. "This case study highlights how systematic biomechanical testing of a race strategy can assist coaches by determining the most beneficial race strategy for a particular athlete." Indeed. [Janssen, I]

Here's a ground-breaking study hidden in the e-posters. **Stretching** impairs explosive per-

formance, right? Well, if it's done as a series of short intermittent stretches it actually *enhances* performance. The subjects were nine elite male **gymnasts** in a crossover comparing a 90-s static stretch of the quads (using a modified version of the Thomas test, with force applied by the investigator) with 3× 30-s stretches and 30-s rests. On the two testing occasions, one leg was stretched while the other served as a control. Single-leg counter-movement jump height showed little change in the control unstretched leg on both occasions, but the continuously stretched leg showed an impairment peaking at -18% immediately after stretching, while intermittent stretching produced an enhancement peaking at 26% 4 min after stretching. By 6 min both forms of stretching produced similar enhancements of ~10%. The author emailed that she is investigating effects of stretching both legs. [Donti, O]

### Injury

**Core stability** assessed with various measures of "lumbo-pelvic control" is associated with 2-3× lower risk of knee injury in **collegiate athletes** and less time lost due to injury in **baseball pitchers**. Core stability can be trained, but the presenter in this symposium did not present evidence of effects on injury incidence in controlled trials. [Chaudhari, A; [ECSS.tv](http://ECSS.tv)]

A 15-min injury-prevention **warm-up** adapted for **football** players less than 12 years of age produced small gains in performance tests relative to control warm-up in a 10-wk randomized controlled trial with 12 teams. This "FIFA 11+ Kids" program looks set to reduce injuries. [Rössler, R]

In a 22-wk prospective study of 264 recreational **runners**, those who reported alternating use of more than one pair of **running shoes** had a moderate reduction in injury risk (hazard ratio = 0.61, a 39% lower risk of injury). Training for other sports was also associated with a small reduction in injury risk (hazard ratio = 0.85). Variation in load is the likely mechanism protecting against overuse injury. [Malisoux, L]

Findings of a Cochrane review of 38 interventions for preventing **ankle ligament injuries** were presented in a confusing manner in the abstract, but it looks like there is reasonable evidence for benefits of **multifaceted programs, bracing** and **neuromuscular training**, whereas there is limited evidence for taping and high-top shoes. [Janssen, K]

## Nutrition

Endurance athletes need **carbohydrate** to replenish glycogen stores, but it's better not to consume the carbohydrate immediately after training. That's the finding in this landmark controlled trial of 23 well-trained **triathletes**. The group who "**slept low**" (by having low carbohydrate evening meals after hard afternoon training sessions) improved their endurance cycling and running performance by several percent more than the control group, who had the usual high-carbohydrate meals. There may have been some contribution from low-intensity morning training sessions, which the sleep-low group performed before recharging with carbohydrate. The two groups otherwise trained the same and had the same overall amount of carbohydrate in their diets [Marquet, L]. This finding is consistent with an emerging new training principle: recovery antagonizes adaptation. In other words, it's better to prolong the training stimulus by delaying recovery. See [this year's ACSM report](#) for another example.

It looks like the **nitrate** in beetroot juice may allow players to do more work in the first half of a game and possibly have faster reaction times in the second half, in this crossover with 16 amateur **team-sport players** performing a game simulation [Thompson, C]. However, athletes considering beetroot supplementation should be mindful of the antagonistic effect of chlorhexidine mouthwash on plasma nitrate concentrations [McDonagh, S].

Mean power in 6-s sprints was 3% greater with beetroot juice containing **nitrate** than without in a crossover with 10 recreational **team-sport players**, but there was little effect on 30-s and 60-s sprints. [Wylie, L] Trivial effects of nitrate-rich beetroot juice on repeated 30-s sprint performance were also observed in a crossover of an unknown number of moderately-trained **athletes**. [Lipski, M]

The outcomes were presented only as p values, but it's reasonably clear from this randomized controlled trial of 30 well-trained **endurance runners** that consuming **whey protein** before and after training sessions for 6 wk did not result in any extra improvement in 6-km performance compared with control carbohydrate supplementation [Sondergaard Thomsen, L].

**Beta-alanine** enhances performance lasting a minute or so probably via buffering of acidity

in muscles, but does it work for endurance? Not in this study: if anything, performance in a 20-km time trial was a little slower (by 0.5%) following 4 wk of supplementation with beta-alanine compared with placebo in a randomized controlled trial with 19 national-level **cyclists**. [Martin, D]

In a crossover study with 14 elite junior tennis players, "a dose equivalent to 3 mg of **caffeine** per kg in the form of an energy drink increased handgrip force, high-intensity running and tended to increase the percentage of points won on service during a simulated **tennis** match." [Gallo Salazar, C]. Caffeine also enhanced performance of 50-m (freestyle?) swim time of 14 elite swimmers by 0.7% [Lara, B].

**Cycling** time-to-exhaustion in the heat was substantially greater with pre-exercise ingestion of a pure **ice slurry** and a 6 mg/kg **caffeine** supplement than with either intervention alone in a crossover of nine male subjects. [Hasegawa, H]

Pre-game consumption of a **caffeinated** energy (carbohydrate) drink improved jumping height and spike velocity, as well as the frequency of positive actions in a simulated game in this crossover study of 13 female **volleyball** players. [Pérez López, A]

A difference in significance between an experimental and control group does not necessarily mean a significant difference, so it's unclear whether the significant 13% increase in strength after one week of **vitamin D** supplementation in 11 **judo** athletes was really different from the non-significant unstated change in the placebo group. [Wyon, M]

## Performance Analysis

The first two speakers in a symposium on analysis of **tactics** in **soccer** explained briefly what could now be described as traditional measures of position on the field of the whole team [Lemmink, K] and of individual players [Sampaio, J]. Such measures have the potential to add value to the usual performance indicators based on what players do when in possession of the ball, but if these speakers had any specific insights into improving a team's chances of winning, they didn't reveal them. The same can be said of the third speaker, Daniel Memmert, who explained how it is now possible to use neural-net modeling to extract tactical measures from the data stream of positional information provided by several proprietary systems for

automatic tracking of all players in real time [Memmert, D]. We have little doubt that this modeling contributed to Germany's dominance in the World Cup. We felt humbled by the advanced level of expertise of these three speakers. We recommend signing up for the master's degree in game analysis at the German Sport University. [IS-SH04]

We missed the symposium on acquiring expertise, but one of the abstracts is surprisingly informative about the predictive **eye movements** of expert **cricket** batters, **football** goalkeepers and **table tennis** players, as revealed by the latest technology for tracking gaze in the field. "These studies help us to understand the strategies that skilled athletes use to perform time-stressed interceptive actions, and help in the development of training interventions designed to improve the interceptive skill of developing athletes" [Mann, D; IS-SH03]. We wish we could access the speaker's slides!

The race-to-race **variability** in performance of elite **alpine skiers** (0.5-0.7%) is about half that of other endurance athletes, possibly because race time is determined largely by the initial sprint phase. The analysis provided estimates of smallest important effects in this sport. [Spencer, M]

A quadratic model with tweaks for the first and last laps looks promising for analysis of **pacing** strategies in 800-m **swimming**. [Lipinska, P]

With a sample size of only nine Division 1 **baseball pitchers**, only really strong relationships between pitching performance in games and **pitching kinematics** (measured for four fastballs, four curveballs and four sliders) would be significant. Only one was: variability in release location, which of course "reduces the anticipatory cues available to the batter" [Whiteside, D]

A cross-sectional study of relationships between **upper-body strength** and double-poling performance of 13 female **cross-country skiers** was bound to detect only obvious strong relationships, again because of the small sample size [Østerås, S]. Multiple linear regression with such a small sample size does not give trustworthy associations. We have not reported on many similar grossly underpowered studies that were presented at this conference.

### Tests, Technology and Monitoring

In a 60-s period following a standardized

submaximal test, **heart-rate variability** ("parasympathetic reactivation") had unexpectedly very strong relationships with peak power and 40-km time (standard errors of the estimate, ~3% and ~2.5%) in a correlational study of 50 trained **cyclists**. Test-retest reliability was also phenomenally high, making this measure of heart-rate variability a candidate for a useful physiological marker to monitor training status without the need for a maximal test. The presenter and co-progenitor of the submaximal test argued that monitoring heart-rate variability after his test is more practical than monitoring it at rest [Lamberts, R]. Maybe resting heart-rate variability gives a different picture, too. In a case study of an elite male **triathlete** over a 32-wk season, better performance was associated with moderate *reductions* in resting heart-rate variability in the week prior to competitions, yet when the athlete was "coping" (presumably less fatigued) in training, heart-rate variability was higher [Stanley, J]. So maybe it's still wait and see with heart-rate variability.

**Heart-rate recovery** following exercise is probably not worth monitoring. In the above study its relationship with performance had twice the prediction error of heart-rate variability [Lamberts, R], and it did not track performance consistently when measured in **cyclists** after a maximal test [Thomson, R] or a submaximal test [Hammes, D].

Relationships between various measures monitored within matches (physical activity) and around matches (blood creatine kinase, jump-test performance, and perceived pain, recovery and fatigue) in 34 **Australian-rules football** players led to the conclusion that the **perceptual measures** were as good as the others for monitoring recovery from matches and "may be appropriate low cost recovery indicators" [Coutts, A].

The German **rowing** team is benefitting from an **auditory feedback** system that converts signals from an accelerometer into sound to enable the rowers to improve their technique [Schaffert, N]. But in a study of seven Dutch rowers using a similar system that included visual feedback, only three rowers appeared to benefit [Lintmeijer, L].

The Japanese have put together the technology for **real-time tracking and assessment** of their **Olympic-class sailing** boats [Hagiwara, M].

High-technology appears to be making useful contributions to **biomechanical analyses** of **alpine skiers** [Kazuhiko, T; Gilgien, M; Supej, M].

A crossover with a 2-wk adaptation period and 7-wk washout showed little effect of **minimalistic shoes** ("Cloudsurfer") on 4-km track performance in 13 recreational **runners** [Lichtenstein, E]. But without prior experience of a lightweight racing shoe, 26 trained runners taking part in a crossover study ran more economically and went 2.3% faster than in standard running shoes in a 5-km treadmill time trial. [Fuller, J] We think the evidence to date supports the use of minimalist shoes on average, but there might be individual differences that benefit (or maybe even impair) performance in some athletes more than others.

**Bigger wheels** are better for **mountain biking**. Eleven national-level mountain bikers rode 2.3% faster with 29-inch rather than 26-inch wheels in a crossover study on a simulated short course (~1200 m). Although there was some evidence of individual differences, all riders had their fastest time on the 29-er [Steiner, T]

#### Talent Identification

Various **anthropometric characteristics** and performance tests of 178 female and 205 male **swimmers** (age 13 and 15 y) were predictors of whether the swimmers subsequently made it to the top 10 in any swimming event at national level. Those reaching the top 10 were late maturers, were taller and had longer limbs. Weekly training volume had little effect in the girls and a surprisingly negative effect in the boys [Alves, F].

#### Training

**Mental fatigue** enhanced endurance training in this ground-breaking randomized controlled trial of 28 physically **active males**. The 14 who trained on a cycle ergometer while doing mentally fatiguing tasks on a computer three times a week for 12 wk experienced more than a doubling of time to exhaustion in a constant-load test (equivalent to ~7% improvement in mean power in a time trial), while the control group of 14 who trained without the mental fatigue improved by a bit less than half as much (~3%). There was no difference between the groups in the improvement in VO<sub>2</sub>max (or in peak power in that incremental test, in a follow-up with the

author), so the improvement in endurance performance seems to be due entirely to a change in the perception of effort at the sub-VO<sub>2</sub>maximal intensity of the constant-load test. Why didn't the treatment improve peak power? Will it work in a time trial with competitive athletes? Time will tell. [Marcora, S]

Here are the main points from Hein Daanen's plenary on **adaptation to heat and cold**: there is no benefit of cold adaptation for exercise in the cold, but adaptation to training in the heat enhances performance at hot *and normal* temperatures, and re-acclimation is rapid (days rather than a week) even after three weeks of de-acclimation. [Daanen, H; [ECSS.tv](#)]

Michael Vogt gave a valuable summary of recent reviews and his own research in a symposium on **concurrent strength and endurance training**. When you do them concurrently in preparation for a competition, the strength training enhances endurance performance, so the traditional "mixed" periodization of strength and endurance training is appropriate for endurance and most team sports. However, concurrent (mixed) endurance training reduces the gains in strength and explosive power that come from strength training, so for sports that require strength and endurance, "block" periodization of the two forms of training is more effective. A program for **alpine skiers** could consist of relatively short (2- to 4-wk) alternating blocks of endurance, strength and skiing-specific training, followed by a 1- to 2-wk taper. [Vogt, M; [ECSS.tv](#)]

**Endurance** training does indeed reduce the effects of **strength** training, shown here with three groups of 10 **rugby** players who did either pure strength training, strength plus high-intensity intervals or strength plus sprint intervals. [Robineau, J]

And strength training does indeed enhance endurance training. In a controlled trial, 11 female **duathletes** who add four lower body exercises of **strength training** twice a week for 12 wk to usual endurance training improved 5-min time trials of cycling and running by 6-7% after prolonged submaximal work relative to the 8 controls. [Vikmoen, O] But endurance training followed immediately by lower body strength training twice a week for 8 wk did not enhance 40-min time-trial or 30-s sprint performance versus endurance training alone in a controlled trial of 20 male **cyclists**. [Psilander,

N] Timing of the strength sessions might explain their failure to enhance endurance here.

The "Cornetti" method of combining **resistance** with sport-specific training was adapted to a combination of dry-land and pool swimming for a 6-wk controlled trial with 20 masters **swimmers**. The method was superior to control training in a tethered performance test measuring swim power, but the effect on performance in a time trial was apparently not investigated. [Leban, B]

Improvements in acceleration from **change-of-direction speed training** twice a week for 4 wk were thought to be responsible for the 1.7% greater enhancement in 30-m linear sprint performance vs repeated sprint training in 17 male junior **soccer** players. [Gundersen, H]

Jens Bangsbo, one of the major players in the field of high-intensity **interval training**, gave an animated Tom Reilly memorial lecture on that topic in the closing ceremony. He presented various mechanisms, but the key point is that its effect on **endurance** performance equals or exceeds the effects of lower-intensity continuous training with much less total volume. Unfortunately there is no abstract or video.

**Interval training** was the topic of two original-research studies earlier in the conference, showing that it doesn't always work as expected. In a controlled trial of 16 male **rowers**, high-intensity interval training three times a week for 4 wk rather than usual endurance training increased  $\text{VO}_2\text{max}$  but had little effect on 2000-m time-trial performance [Cheng, C]. Performance in a 1500-m time trial was unexpectedly 2% slower when the final interval-training session in the taper was performed at 115% of race speed rather than the usual 100% in this crossover study of 10 well-trained male middle-distance **runners**. "A greater reduction in training volume during the taper with the higher intensity intervals might be necessary." [Spilsbury, K]

If the endurance event includes **downhill running**, make sure the training does too. That's the take-home message from this randomized controlled trial of 16 male subjects, who trained for 9 wk and included nine 40-min sessions of either running downhill (-10% grade) or level running on a treadmill. The downhill group had lower heart rate, perceived exertion and pain during and in the weeks following a submaximal 30-km run that included

some downhill running. The presenter made the point that distance running events even on the flat incur a huge number of eccentric contractions, so inclusion of occasional bouts of downhill running in preparation for such events is likely to enhance performance. [Lambert, M]

**Overload training** followed by a taper is the way to get super-compensation in performance for a competition, but here's a controlled trial showing that it's important not to overdo it. After 3 wk of overload training, 12 male **triathletes** experienced a 2% improvement of (peak power?) performance, while 11 were impaired by 2% (and were therefore "functionally overreached"), and a group of 10 doing control training improved by 1%. Two weeks later in the taper, the first group experienced the maximum improvement of 4.5% above baseline, while the control group reached 1.5% and the overreached group reached only 1.0%. [Le Meur, Y]

Owing to program clashes, we missed a valuable symposium on perceptual training in sport (and there is no video). Our summary is based on the limited information in the abstracts. "**Visual-control training** in which vision is systematically manipulated, either using screens or special occlusion goggles, provides a promising tool to be used in sports practice to improve performance." This conclusion is based on research on **basketball** jump shooting, in which visual-control training generally led to higher shooting percentages by "forcing players to use optimal information" [Oudejans, R]. Accuracy in skilled movement of novices and experts in sport and other performance domains can also be increased by training the **quiet-eye** period, which refers to the fixation of gaze observed immediately prior to movement in aiming tasks. (See [this website](#) for an overview.) "Quiet eye training is more effective than traditional scripts focusing on movement control." [Wilson, M]

Recovery with whole-body **cryotherapy** "helped preserve sleep quantity and prevented significant rise in perceived fatigue" during periods of intensified training in a controlled trial of an unstated number of elite **synchronized swimmers**, but one of the slides of the mini-oral presentation shows evidence that 400-m swim speed tended to be impaired [Schaal, K].

**Functional core training** is an effective way to enhance dynamic balance in **tennis**

**players**" is the conclusion in this randomized controlled trial of 30 male tennis players (mean of 7 y tennis experience) comparing additional core or resistance training with usual training. The effects can't be assessed properly, because they are reported only as p values. [Ng, S.K]

One of the most interesting presentations of the conference was hidden in the e-posters: a potential treatment for **muscle cramp**. It was shown recently that electrical stimulation of muscles induces cramp with a lower frequency of stimulation in individuals prone to cramp (typically 15 vs 25 Hz). The researchers here found that inducing cramp twice a week for 3

wk by electrical stimulation of calf muscles in a shortened position raised the cramping frequency in 10 **healthy males** to 33 Hz. Does the treatment reduce the risk of cramp during long hard exercise, and if so, how long does the protection last? The author emailed that research is in progress. [Behringer, M]

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