

THE JOURNAL OF THE UK STRENGTH & CONDITIONING ASSOCIATION

# PROFESSIONAL STRENGTH & CONDITIONING

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2019



**MANAGING RETIREMENT  
REFLECTION IN S&C  
UKSCA ANNUAL AWARDS**

# UKSCA ASSESSMENT DAYS

Please see our website for the latest dates and availability, as demand is high and new dates/venues are being added every week.

In order to become UKSCA Accredited, members must prove their competence as an S&C coach on one of our assessment days. Places are available on each day below for those coming for their first assessment day, as well as those looking to retake one or more elements.

13 Jul 2019 – St Mary's, Twickenham

14 Jul 2019 – St Mary's, Twickenham

17 Aug 2019 – Loughborough University

18 Aug 2019 – Loughborough University

07 Sep 2019 – Manchester Institute of Health and Performance

08 Sep 2019 – Manchester Institute of Health and Performance

19 Oct 2019 – Edinburgh University

20 Oct 2019 – Edinburgh University

26 Oct 2019 – Buckinghamshire New University

27 Oct 2019 – Buckinghamshire New University

09 Nov 2019 – University of Ulster, Belfast

30 Nov 2019 – Manchester Institute of Health and Performance

01 Dec 2019 – Manchester Institute of Health and Performance

# UKSCA

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WRITING FOR THE JOURNAL

# Changing your mind: a sin or a strength?



One of today's great paradoxes is that, despite the seemingly endless proliferation of scientific research in strength and conditioning, it appears we are living in a world of ever-increasing extremes, of deeply entrenched viewpoints, all claiming to be evidence-based. In these increasingly factious times, woe betide any apostate or even anyone who even dares to think about changing their mind. In today's world, changing one's mind seems to have become the hallmark of the vacillator, of someone lacking belief and commitment – a person whose vicissitudes will preclude them from ever being successful. Indeed, wherever we look, we find otherwise rational individuals making extraordinary efforts to avoid changing their minds, or at least not to be seen to be changing their mind.

Yet science consistently teaches us that certainty is illusory, that we should never claim to know the absolute truth – however comforting that may seem. In fact, our belief in an idea should never approach either zero or 100%, as evidence will always emerge which questions our beliefs and understanding. In effect, all we can realistically do is quantify how likely to be an occurrence is, or how unlikely.

As a result, the ability to change our minds, even about our own deeply held views, is the basis upon which our profession will move forward. In the words of George Bernard Shaw: 'progress is impossible without change, and those who cannot change their minds cannot change anything'. With the ever-growing amount of information, much of which will question many of our beliefs, a degree of doubt would therefore appear to be a healthy and natural situation and, consequently, changing our mind should be a sign of strength rather than weakness.

If we are truly becoming more scientific in our approach, then surely these seemingly immutable positions should become less common, yet they seem to be proliferating. Even worse, anyone who has the audacity to question these positions is often subjected to the wrath of the devotees – how can this be? Rather contrarily, part of the answer may lie in how the information is processed.

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**'Progress is impossible without change, and those who cannot change their minds cannot change anything'**

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Psychologists have identified a process called 'motivated reasoning', whereby the mechanisms through which we process information confirming our beliefs is fundamentally different from how we process information that contradicts them. When we encounter information that concurs with what we already believe, we readily accept it as a fact – as another piece of confirmatory evidence that proves we are right. However, when we are exposed to information that contradicts our deeply held beliefs, we require convincing: we scrutinise the evidence, looking for flaws which can allow us to first question and then ultimately ignore the evidence.

In our increasingly myopic world, it becomes ever easier to find evidence to support our beliefs, to find groups who share these beliefs, and to find a vocal minority who actively promulgate these beliefs. In these instances greater information – especially of the soundbite variety –

simply forms an echo chamber where our original beliefs are reinforced, not through objective reasoning but through motivated reasoning. Add in the challenge of confirmation bias, where we actively search out and prioritise evidence that supports our position and obduracy can become an inevitability.

Clearly, changing our mind should never be seen as the ultimate sin. However, this is not to say that we should change our mind like the wind, flip-flopping between approaches, systems and methods at the drop of a hat: that would never work. So, ironically, there is a lot to be said for having strong beliefs. In politics we often praise the politicians who state what they believe, who stand by their convictions and promote a strong and consistent message, and we decry the individual who avoids answering questions, whose position is vague and seems to vary depending on the flavour of the day. Let us transfer this to the training environment: if we ourselves don't believe in what we're doing, how can our athletes ever have faith in what we are saying and in the methods we deliver?

A clear and consistent message is crucial to effective coaching and, without this, it is unlikely that we will ever engender the trust and clarity of purpose that is required to generate consistent results. Yet there is a fine line between traditional and obsolete, and between consistency and obstinacy and we must tread this fine line carefully. 'Strong beliefs, lightly held' may be an important phrase moving forward, allowing us the consistency and strength of message that provides clarity and purpose, but also the ability to adapt and evolve the message as evidence emerges.

**Ian Jeffreys, PhD, FNSCA, ASCC, CSCS\*D, RSCC\*E, FUKSCA**

## NEWS

# UKSCA BOARD ELECTIONS 2019

## NEW BOARD MEMBER RICH CLARKE

We are pleased to welcome Rich Clarke as a new member of the UKSCA's Board of Directors. Rich is currently course leader on the MSc in sports strength and conditioning at the University of Gloucestershire and has worked as a strength and conditioning coach for the last nine years with a range of athletes and ages.

Rich says: 'In a period of growth and development, it is important not to lose sight of those members who are looking for support from the organisation ... the Association is in a great place and the future is extremely bright for the profession; however, we should not become complacent simply because things aren't broken. From an individual perspective, I believe I will bring four key traits to the Board: passion, productivity, creativity and transparency'.



## RE-ELECTED BOARD MEMBERS

### CHRIS BISHOP, DAN CLEATHER, RICH HUNWICKS

The UKSCA is delighted to announce that they have re-elected to the Board as directors both Chris Bishop and Rich Hunwicks, as well as Dan Cleather as finance and administration director, all to serve for another two years.

## UPCOMING REGIONAL EVENTS AND MASTERCLASSES

– see our website for further details

### MENTOR TRAINING WORKSHOP

**17 JULY 2019, MANCHESTER**

This one-day workshop has been designed to upskill members in their mentoring of other coaches and is a great opportunity to learn in a small group alongside other strength and conditioning coaches. **Only £75 for members for this world-class development opportunity.**

### SCOTLAND S&C REGIONAL

**24 JULY 2019, MURRAYFIELD, EDINBURGH**

This evening event, running from 1800–2100, will enable members to hear sessions from: Nick Lumley, head of strength and conditioning at Edinburgh Rugby, discussing 'Constraints led approach to motor learning'; Tony Tompos, first team physiotherapist at Aberdeen FC, discussing 'ACL rehabilitation in football'; and Scott Crawford, sportscotland Institute of Sport, discussing 'Developing the Snowsports athlete'. **Only £25 for members.**

### RUNNING DEVELOPMENT MASTERCLASS 25 JULY 2019, BUCKINGHAMSHIRE NEW UNIVERSITY

This practical session, run by Andy Hudson, will look at the principles of developing a 'running pathway' from straight line to sport-specific speed. This can be adapted to develop youth athletes, as well as inform the appropriate progressions post-injury. **Only £45 for members.**

## UKSCA GRANTS

### EARLY CAREER DEVELOPMENT GRANTS

Applications are now welcome from employers who are running well-structured internship/coach development programmes, who would like to incorporate UKSCA's education and training workshops into the development plans of their coaches. Successful employers will also receive a free place on our Mentor Training workshop that aims to further raise the standards of internships and coach development in the UK. The deadline for applications is 10 July 2019.

### COMMUNITY AND FACILITY DEVELOPMENT GRANTS

Awards of up to £5000 are available and applications are welcomed to support a range of projects: promotion of S&C initiatives (sports performance, physical activity, movement coaching); the development of community and/or outreach projects; the development of S&C in education, youth and amateur sports participation; support for S&C development through the purchase of equipment. The deadline for applications is 26 July 2019.

### RESEARCH GRANTS

Awards of up to £2000 are available and applications are welcomed to support research that furthers the understanding of physical preparation for performance-based outcomes that will be of interest to Association members; they are also available for consumables to support research projects. The deadline for applications is 26 July 2019.

Application forms for all these grants can be downloaded from our website.

# UKSCA 2019 EXCELLENCE IN S&C AWARD WINNERS

## PETE MCKNIGHT AWARDED AN UKSCA HONORARY FELLOWSHIP

**AWARDED TO THOSE WHO HAVE MADE EXTRAORDINARY CONTRIBUTIONS TO THE UKSCA AND THE PROFESSION THROUGHOUT THEIR CAREER**

Pete was a Board Director for the UKSCA from 2009-2013 and then went on to become Chairman of the Board from 2013-2018, before stepping down last summer. He helped to set exceptional standards of conduct and communication, demonstrating patience, approachability and a willingness to explore new ideas, which has been a real catalyst for the UKSCA to embrace and support the growing diversity of what it means to be a strength and conditioning coach. Pete is currently director of coaching and sport science at Hinsta, working around the globe in F1 and Motorsports and managing over 20 other S&C coaches. Previously, he worked across multiple sports, countries and cultures with Olympic and professional athletes in sports such as rowing, athletics, cricket, swimming, football and alpine skiing.



As a consequence of his leadership and innovative ideas, key initiatives – such as the creation of panels for research grants, community grants and early career practitioners – have ensured that the UKSCA can give back to those members who are disseminating best practice, while at the same time also furthering their own personal development. Pete's life statement is 'to see people grow, develop and reach their potential', highlighting a truly selfless commitment to the success of others: something he did for nearly nine years on behalf of UKSCA members. We are currently entering a very exciting time for our profession and none of this would have been possible without the exemplary leadership skills of Pete, who took the UKSCA to a point of growth and stability in the last few years.

## S&C COACH OF THE YEAR – EDUCATION AND RESEARCH: JAMES KEENAN

**AWARDED TO A UKSCA ACCREDITED MEMBER WHO HAS MADE SIGNIFICANT CONTRIBUTIONS TO THE EDUCATION OF S&C COACHES, OR WHO HAS PROGRESSED THE PROFESSION THROUGH RESEARCH**

Over the past five years, James has been one of the industry leaders in developing applied research in the form of MRes programmes within elite sporting organisations. These MRes degrees have been in conjunction with professional football and cricket clubs, such as Derby County, Leicester City and Derbyshire County Cricket, and have provided practitioners with the perfect balance to enhance and develop their coaching skills as well as answer important questions for the clubs in an applied research setting. In football, common research strands have revolved around monitoring training load for elite youth academy players and how this differentiates between playing positions, investigating differences between training days versus match days, and the potential association between training load and injury risk.

The success of this MRes programme is highlighted by the high-level of career progression many have achieved, gaining full-time employment in professional sporting organisations such as Leicester City FC, Sheffield Wednesday FC and Derbyshire County Cricket.

James has also single-handedly developed the S&C undergraduate degree programme at the University of Derby. The strong focus on applied research in elite sport on the MRes programme has been used to provide undergraduate students with real-world examples of what it is like to be an applied practitioner, but this is constantly underpinned by progressive academic knowledge.





## S&C COACH OF THE YEAR – DEVELOPMENT SPORT: **DAVE HEMBROUGH**

**AWARDED TO A UKSCA ACCREDITED MEMBER WHO HAS MADE SIGNIFICANT CONTRIBUTIONS TO THE EDUCATION OF S&C COACHES, OR WHO HAS PROGRESSED THE PROFESSION THROUGH RESEARCH**



Dave has been a UKSCA accredited coach since 2008 and has made an enormous contribution to the profession at all levels during this time. This has included work with numerous elite athletes and sports teams, ranging from professional boxing and athletics to supporting athletes competing at the Olympics. In addition, he has an extensive record of coach development, mentoring over 20 young coaches to successfully achieve UKSCA accreditation and subsequently go on to have excellent careers within the S&C industry.

Over the years, Dave's passion has gradually shifted from sports performance to non-elite sport and the role that an S&C coach can have in participation, health and well-being, as well as in working with diverse community groups. He founded the Hallam Barbell weightlifting club in 2009, which has developed into an award-winning club for the wide-ranging programmes that it delivers. It is one of the longest serving programmes at Sheffield Hallam and has seen over 800 people complete the Hallam Barbell 'learn to lift' programme, 500 women attend the Powerbelle female-only programme, and 150 children complete weightlifting courses with the Hallam Barbell Bears class. The programme has also diversified in recent years, offering lifting classes for older adults and individuals with disabilities too.

Consequently, these programmes are improving the health and quality of life for all involved as well as being delivered within a framework that produces applied research and supports further development of young S&C practitioners' skill-sets by working with special populations.

## S&C COACH OF THE YEAR – YOUTH SPORT: **LUKE JENKINSON**

**AWARDED TO A UKSCA ACCREDITED MEMBER WHO HAS MADE SIGNIFICANT CONTRIBUTIONS TO THE DEVELOPMENT OF YOUNG ATHLETES**

Luke is well-known for his dedicated work in elite youth football. He currently holds the position of head of academy sports science and medicine at Derby County Football Club, where he employs a truly holistic view on athlete development and well-being. This involves prioritising communication within a multi-disciplinary team environment and keeping S&C coaches, sports science and medical practitioners involved at all stages of athlete preparation, thus ensuring that an athlete-centred approach remains priority number one.

He was previously a S&C coach in the Sheffield United Academy, where he introduced alternative strategies (in addition to traditional S&C practice) to enhance the physical literacy of youth players, most notably in the form of gymnastics, which provide the perfect blend of strength, conditioning and fun. This ensured that players remained fully engaged in the S&C process, while developing robust athletes for improved physical performance and reduced injury risk.

Luke's fun and interactive personality, coupled with superb inter-personal skills, is one to which youth players warm, thus ensuring the best is achieved from those working with him.

His extensive experience and understanding of the application of long-term athletic development led him to the position of associate lecturer in strength and conditioning at Derby University. His experience in youth football has helped to bridge the gap perfectly between under-pinning theory for youth training and real-world practice, providing fantastic insights for the S&C students of Derby University. He has recently begun a PhD course investigating the importance and usefulness of isometric strength at Liverpool John Moores University.



## S&C EMPLOYER OF THE YEAR – EARLY CAREER COACH DEVELOPMENT: **LOUGHBOROUGH SPORT STRENGTH AND CONDITIONING**

**AWARDED TO A CLUB OR ORGANISATION WHO HAS SHOWN COMMITMENT TO DEVELOPING COACHES IN THE EARLY STAGE OF THEIR CAREERS**

This team of nine permanent staff, all UKSCA accredited coaches, work across 15 university performance sports and three franchises, as well as providing S&C support to TASS athletes and private clients. They have two full-time undergraduate placements and one part-time Masters placement, all progressing towards UKSCA accreditation. A further four junior S&C staff are working with sports and athletes at Loughborough College under the guidance and mentorship of senior staff and through Loughborough's Coach and Volunteer Academy: this team provides voluntary placement experience to over 30 S&C students each year.

The team runs structured weekly CPD sessions within the S&C department, which focus on a wide range of topics that coaches feel will enhance delivery and interaction with both elite and student athletes. There is also a 'Round Table' each week led by permanent staff, for junior staff and placement students, enabling each member of the team to lead on a particular topic of their choice: this provides an opportunity for developing coaches to gain an understanding of senior coaches' philosophies and strategies to achieve specific objectives.

The constant mentoring from senior staff ensures that students receive an in-depth understanding of real-world application for elite and student athletes. Finally, the extensive network of the senior staff have enabled



student placements to a wide variety of sporting organisations including: Leicester Tigers, Leicester City FC, Wales Rugby, Tottenham Hotspur FC, Bournemouth FC and Norwich City FC, among others.

## RICHARD HOLMES AWARD FOR THE EMERGING S&C COACH OF THE YEAR: **ADAM BURTON**

**AWARDED TO A UKSCA ACCREDITED OR ASSOCIATE MEMBER WHO HAS SHOWN OUTSTANDING PROMISE, DEDICATION AND PASSION IN THEIR NEW CAREER IN S&C**

Adam has demonstrated conscientious and meticulous planning when aiming to prepare a wide range of athletes for optimal athletic performance and it is this level of detail that has led to the development of his own philosophy of training, which has seen much success.

His time at Leicester City Football Club showed an eye-opening desire not only to improve his understanding of the underpinning science associated with planning field and gym-based training, but also in the softer coaching skills and ability to positively interact with players of all ages. This culminated in a significant and positive impact on many junior players during key stages of youth development during one of the most successful periods of under-21 football at Leicester City in the last few years.

In 2018, he moved to St Georges Park where his current role involves working with the PFA rehabilitation scheme. His ability to utilise technology in a simple, productive and motivational manner has been hugely successful here. He also works as a consultant physical performance coach with the England Youth squads, work which demonstrates his ability to programme and deliver high quality S&C training to athletes of all ages at the highest level of youth sport.



## POSTER AND ORAL PRESENTATION AWARDS

At this year's conference, 39 posters were accepted, which once again demonstrate the breadth, depth and great work of our membership through research and applied case studies. The following posters were presented with £100 book vouchers, kindly donated by Routledge for best posters of 2019:



**Chien-Chung Chang**, National Taiwan Sport University, **Shu-Huan Lin**, Hong Kong Sportsline Asia Co. Ltd, **Chien-Ying Chiang**, National Taiwan Sport University  
*'A study into countermovement jump eccentric phase performance and jumping height in collegiate athletes.'*



**Ed Harper, Steve Thompson (pictured)**, Sheffield Hallam University  
*'The effect of an 8 week strength and conditioning programme on competitive youth swimmers'*



**Gill Myburgh**, Lawn Tennis Association  
*'Developmental fitness curves, an innovative strategy for assessing acceleration relative to age and maturity in elite youth tennis player'*



**Emma Archer**, St Mary's University, Twickenham  
*'The effect of short-term weightlifting derivative training on vertical impulse, handspring vault performance and kinematics in addition to self-efficacy and outcome perceptions in female youth gymnasts'*

# UKSCA GRANTS: How to make a successful application

In 2015, the UKSCA launched an initiative to provide financial support to community and research projects being (co-)led by Accredited members. Twice each year, coaches are invited to apply for financial grants to support the development of worthwhile projects, which are subsequently scrutinised by a grants panel made up of experienced coaches and academics.

There are a high number of potentially worthwhile projects which are rejected due to a lack of detail being provided and/or poor clarity for the project rationale. To maximise the likelihood that future grant applications will be successful, the grants panel suggest that applicants ask themselves the following questions during the planning of their projects before submitting their application.

## GENERAL CONSIDERATIONS:

- Can the organisation with which the coach/es are affiliated actually fund the project without the assistance of the UKSCA? It is often obvious for small-scale community projects that the coach is virtually unsupported; however, other projects, which are based at large clubs or organisations, should demonstrate why funding cannot be sourced from that institution.
- Is the funding to pay for staff time? If so, it should be clearly stated why this is not part of the current applicant's job remit. In addition, if funding is requested to 'buy-out' or pay for staff/coaches' time, how will this be replaced once the money has been spent?
- Will the money be used to fund coaches to attend UKSCA workshops and/or assessment? If the answer is 'yes', it is likely that the application will be rejected. The aim of the UKSCA grants initiative is to provide funding to support novel projects.
- Does the project have matched funding from the applicant's organisation? If evidence can be provided that funding of a similar amount can also be provided by another institution, this type of grant application is more likely to be looked upon favourably.
- Are the objectives SMART (Specific, Measurable, Agreed with institution, Realistic, Time-phased)? Often vague objectives, such as 'to increase participation numbers', demonstrate a lack of thought and consideration for what the applicant actually wishes to achieve with the project. Objectives should provide a specific and measureable outcome, against a backdrop of what currently exists (achievable). Application should also include an approximate date by which the project objectives will be achieved.

## SPECIFIC CONSIDERATIONS:

### COMMUNITY

- Will the project engage more members of the local community in strength and conditioning? The fundamental aim of this type of project is that the project engages more of the community in appropriate strength and conditioning (S&C) activity.

- Is the project sustainable once the money has been spent? Frequently applicants intend to use the money simply to start up a new project; they are not clear as to how the project would continue once money has been spent.
- Will the money be used for the purchase of new equipment? Replacing old/broken equipment is a common rationale for funding. However, this is often an insufficient reason and applicants should demonstrate how purchasing new equipment will engage more of the community in strength and conditioning. A breakdown of the likely supplier(s) of the equipment and associated costs should also be provided.
- If the project is completely new, what information/data indicates that there is a need/market for the initiative being proposed? Novel and completely original projects are encouraged; however, investing money in this type of project carries a higher risk for the Association. Therefore, applicants proposing funding which is to 'start up' a project are required to provide a rationale which includes market research, pilot testing and potentially evidence from community groups that the demand actually exists.

### RESEARCH

- Would the research findings directly inform S&C coaching practice? The more far-reaching and practically relevant the research is, the better. The UKSCA panel are unlikely to award funding to highly mechanistic research or projects with limited applicability. Similarly, outcomes which are relevant to coaches, but require expensive sophisticated equipment for practitioners to implement are less likely to be funded.
- Has ethical clearance been granted? All research projects require ethical approval before participants can be recruited and data collection begins.
- Will participants receive any financial remuneration for their involvement with the research? For most S&C research projects which use non-invasive techniques and are not particularly time-consuming, paying participants is unnecessary. If participants do receive payment, this is an important ethical issue in its own right, and should therefore be addressed as part of the proposal.
- Is the research question clear and methods sufficiently robust to answer the question posed? Sufficient detail surrounding validity and reliability of data collection tools and procedures should be provided. Proposals which have vague research designs are unlikely to be considered.
- Is this funding to be used to purchase consumables/equipment for the research project? If so, then a detailed breakdown of the costs based on estimated sample size would be required to ensure that the project does not run out of funding to complete an adequate sample to provide clear statistical significance/worthwhile effects from the data collected.
- Is this funding to pay for a studentship, or contribute to student fees to complete research? If so then it should demonstrate that the research is novel enough to require funding and that UKSCA funding is vital to the completion. Projects with match-funding towards the students fees would be looked upon favourably.

## CHAIRMAN'S COLUMN

It feels like this issue's column is a great time to reflect on the success of this year's annual conference and for those who were in attendance, I hope you had a thoroughly enjoyable weekend. To those who were unable to attend, some pages in this issue should give you a brief overview of some of the fantastic content that was shared and we really hope to see you next year.

Personally, I thought it was fantastic and it's always so enjoyable to bring coaches and academics together in one place to share ideas, catch up with old friends and make new acquaintances. The talks provided such a broad spectrum of information from which we were all able to learn, and I thought the addition of the short talks was extremely valuable as well, enabling those who were presenting to engage in wider discussion with an audience to whom they may not normally have access. In addition, the poster presentations were superb and really showcased the high quality of work being conducted both in elite sporting organisations and at HE institutions. With that in mind, congratulations to all the

award winners, which included our 'Coach of the Year' categories, and winners for our short talks and poster presentations as well.

I'd also like to extend my sincere gratitude to the National Strength and Conditioning Association and the Australian Strength and Conditioning Association, both of whom continue to honour our reciprocal speaker agreement. It's always an absolute privilege to have you support our annual conference and I thought the talks from both Travis Triplett and Emily Nolan were outstanding. Finally, a big and heartfelt thank you to our conference director Anthony Turner and the team behind the scenes: Sarah, Helen, Janet, Louise, Mary, Olivia, Katie, Rob Pacey and the AV team, without whom we would have been completely lost – your efforts in ensuring the smooth running of the conference were invaluable.

Aside from the conference and as a parting thought, we have recently completed the second draft of the professional standards documentation for the position of 'S&C Coach' in partnership with CIMSPA. A special mention must go

to Pete Mundy, Rob Meyers and Paul Comfort for their extensive assistance in helping prepare these standards to the level they

are today. These standards will soon be sent out for wider consultation where you, the members, will be given the chance to read and provide feedback on the documentation thus far. Our aim is to send this documentation to the professional development board in early September, and we are hopeful that with your input, these standards will be ratified soon after, representing the second professional standards document for the strength and conditioning profession. You can read more about this on page 22.

As always, if anyone has any queries or would like to get in touch with me, please do so using the email address below and I look forward to hearing from you soon.

**Chris Bishop**  
[chris@uksca.org.uk](mailto:chris@uksca.org.uk)



## NEWS

### UKSCA Special Interest Groups (SIGs)

#### 14 June 2019 meetings

After significant interest was shown in the idea of developing Special Interest Groups (SIGs) within strength and conditioning, we decided to take the opportunity to explore this at our Annual Conference. We asked members in advance to let us know if they were interested in the launch of these SIGs in six key areas: football, gym owners, HE providers, university coaches, health and wellness, and schools. Then on the pre-conference day (June 14) at Milton Keynes we held meetings in these six areas with members who had expressed an interest.

As the ongoing success of SIGs relies on members' involvement, these meetings were also an indicator of whether there is an appetite in the membership to set them up and keep them going. We are pleased to say that there is, but we also recognise that we are still at an early stage, and that there is still much work to be done to support them.

However, we hope that the wider membership will see the value of engaging with them.

For those that haven't already signed up, we will contact members through our monthly email newsletters with details of each SIG and how you can get involved.

The turn-out at the actual meetings was varied; however, feedback from these meetings was very positive indeed, with 'networking and sharing of information between members' within the groups a common aim. In addition, group-specific actions were identified – such as in football, 'to create a vehicle whereby a greater quality of applied research findings could be identified through sharing of anonymous club data to independent research groups'.

The groups have all identified actions for the next six months and we will be publishing further developments as they arise.

# Managing the transition into retirement from sport for elite athletes

By **Chris Hattersley**, *MSc, MSc, ASCC, CSCS*,

**Dave Hembrough**, *MSc, PGDip, ASCC*, **Kaseem Khan**, *MSc, CSCS*, **Andy Picken**, *MRSPh*,

**Tom Maden-Wilkinson**, *PhD*, **James Rumbold**, *MSc, PhD*, *Sheffield Hallam University*

## OVERVIEW

The aim of this article is to raise awareness, among strength and conditioning (S&C) coaches, of the challenges that may be encountered by elite athletes as they transition into retirement from their sport. This will include a discussion of common themes identified in the athlete well-being literature, as well as a review of the athlete support systems for a range of sports. The aim of both of these perspectives is to enhance the welfare of athletes throughout this period of their athletic careers.

## Introduction

The transition into retirement represents a challenging part of athletes' careers as they enter a new period of their life after sport.<sup>1</sup> Unlike other careers, most athletic retirement normally occurs relatively early in life and – because of this – athletes face an extensive range of psychological, social and occupational adjustments as their identity shifts to that of being a former athlete.<sup>2,3</sup> Furthermore, although planned retirement is the most common route into ending an athletic career, there is also a degree of uncertainty regarding when retirement will occur for athletes as retirement can be forced by injury or deselection.<sup>4</sup>

In addition to the immediate changes in an athlete's life post-retirement, they also need to be educated to self-manage any previous medical or physical issues that may have a lifelong effect, as support will be substantially reduced when they leave the high performance system.<sup>5,6</sup> Due to the diverse combination of potential problems that athletes may face when retiring, it is essential to review these in order to raise awareness for athletes and members of the high performance team.

## Planned and unplanned retirement

Competitive sports retirement represents a unique period of life change, as – unlike retirement from other careers – it usually occurs early in life.<sup>7</sup> Although retirement is an inevitable part of any athletic career, the unpredictable nature of elite sport means that there is usually a degree of uncertainty as to when this will occur, with athletes undertaking planned retirement when their sporting career has run its course, or else forced retirement through either injury or deselection.<sup>4,5</sup> Planned retirement is associated with less adjustment difficulties, whereas forced retirement is associated with an increased risk of mental health problems.<sup>8,9</sup> Retirement that is forced upon an athlete by injury or deselection is associated with a substantial psychological effect due to the lack of an adjustment period.<sup>5</sup> The degree of voluntariness during sporting retirement is highly associated with better outcomes as there has normally been time to pursue other interests and prepare for life after sport.<sup>10</sup> Although this is usually the case, ultimately the impact of adjustment difficulties depends on the individual's coping and support resources, as well as the degree to which they have



***Gary Lineker has demonstrated only too clearly how easily an elite athlete can find a new career pathway after sport***

planned for occupational alternatives before they retire.<sup>3,7</sup> For these reasons, an increasing demand is being placed on sports clubs and government bodies to bring these issues to the attention of athletes and to provide the necessary support both during and after the sporting career.

### **Athletic identity**

Elite athletes dedicate themselves to their chosen sport physically and mentally from a young age in order to achieve their athletic goals and it is due to this that they attribute a large proportion of their self-identity to the sporting version of themselves.<sup>6,11</sup> This often results in sacrificing commitments towards education, peers, family and romantic relationships, which do, however, become prominent safeguards during the

retirement process.<sup>38</sup> It is widely reported that those athletes who identify themselves strongly and exclusively with their athletic identity experience more adjustment difficulties than athletes who have less 'self-narrowing' of their identity.<sup>8,9,12</sup> This is due to the adjustment challenges of re-organising one's personal and social goals once sport is no longer the main 'priority' in a person's life. Any psychological problems faced by athletes after retirement, either through forced or unforced retirement, are believed to be heightened according to the degree to which an athlete associates their self-identity with the athletic version of themselves.<sup>8</sup> Athletes who associate themselves strongly with their sporting identity in this way undergo an initial stage of shock and a grieving process that represents an experience comparable to a bereavement of their former selves.<sup>9,11</sup> Due to this, it is

important for athletes to better balance their interests outside of the sporting world in order to safeguard themselves from the potential issues associated with exclusively identifying with themselves as 'the athlete'.<sup>13</sup> Those athletes who do not do this will need to prepare for redefining their identity, in order to help restore and maintain a positive self-image, which may be important to reduce the negative external influences that can occur.

### Sense of personal control

The highly structured nature of elite sports may also limit athletes' sense of control outside of the sporting world as their daily routines, behaviours and decision-making processes are often made by their coaches or sports associations.<sup>7</sup> This lack of personal control may cause problems for athletes when adjusting to their non-sporting identity after retirement, due to the loss of structure, routine and discipline to which they were previously accustomed.<sup>4,7</sup> Indeed, the intensive and enduring training schedules to which athletes adhere and also enjoy during their careers are also often difficult to duplicate outside of sport.<sup>39</sup> Many athletes report that being excluded from the social practices of their sport, as well as the loss of camaraderie with teammates and the joy of competition, were key parts of their sporting life which they struggled to replace after retirement.<sup>6,9</sup> It has also been reported that the loss of identity and prestige of being an elite athlete can lead to problems with an athlete's sense of personal control.<sup>8,9</sup> However, many athletes are happy to be free from the stresses of high performance and look forward to their lives after sport.<sup>8</sup> Team-mates, coaches and sport organisations can play a key role in discussing their feelings about the athlete's looming retirement and help them to plan accordingly. This can give retiring athletes a greater sense of personal control over the transition.

### Occupational adjustments

One of the primary challenges associated with the early retirement age of former elite athletes is how and/or whether they need to transition into a new career.<sup>1,5,14</sup> A unique consideration for athletes during this process is that some may have to retrain for a new occupation, whereas other athletes may have the financial security not to have to work.<sup>3,10,14</sup> There are potential issues with either route, as the athletes undertaking

a new career have to reconstruct a new sense of self, whereas the financially secure athlete has to work out how to fill the times and routines of their previous sporting schedule.<sup>5,14</sup> A lack of formal qualifications for many former athletes has been shown to be a problem that is encountered during their transition into a new career; and for those athletes who are wealthy enough not to have to work, poor financial advice has led to several issues.<sup>14,15</sup>

It is important to note that although problems are experienced by a substantial number of athletes when starting a new career, there are many athletes who use the skills and experiences developed during their sporting life to flourish in other roles.<sup>14</sup> Therefore, it is important for sporting organisations to offer mentoring opportunities and life skills education during athletes' careers in order to help athletes to develop a stronger understanding of how their skills in sport can be transferred in to other vocations, which will smooth the transition into retirement.<sup>3</sup>

### Medical and lifestyle self-management

The demands of training at an elite level over an extended period of time put an athlete at an increased risk of sustaining a musculoskeletal injury.<sup>16</sup> In particular, musculoskeletal injuries to the upper and lower limbs are widely reported in elite athletes.<sup>17,18</sup> During a sports career, these injuries might be recurrent and may lead to surgical treatments and long-lasting rehabilitation programmes.<sup>19,20</sup> The injuries sustained during a sporting career have a lifelong effect, with elite athletes being shown to have an increased risk of osteoarthritis compared to the general population and other occupational sectors.<sup>16,21</sup> In later life, 65% of former athletes with osteoarthritis have reported being in pain during activities of daily living and 37% reported having anxiety or depression due to this.<sup>16</sup> Furthermore, contact sports that involve repeated collisions to the head put athletes at the risk of sustaining repeated concussions and this is associated with a potential risk of acquiring neurological conditions, such as chronic traumatic encephalopathy, dementia and depression post-retirement.<sup>22,23,24,25</sup>

As well as any medical issues encountered during retirement, athletes also report experiencing problems managing their physical condition and nutritional practices after they have finished competing.<sup>26</sup>

**'The injuries sustained during a sporting career have a lifelong effect'**

## **‘athletes also report ... problems managing their physical condition and nutritional practices after they have finished competing’**

Athletes receive limited support with these issues when they leave the high performance system, which can be a further source of psychological stress.<sup>4,5</sup> Due to this, governing bodies should consider a medical consultation as an essential part of an athlete's exit strategy from sport to increase awareness of the appropriate medical options for managing their long term health.

### **Mental health**

The multiple changes that occur in both an athlete's lifestyle and in his/her self-identity during the retirement process can place them at a relatively high risk of developing a mental health problem.<sup>6,27,31</sup> Failure to cope with retirement can lead to psychological pathologies, substance abuse and financial problems.<sup>9,13</sup> This can manifest itself in conditions such as anxiety, depression or post-traumatic stress disorder and can have a significant impact on the athlete and his/her family's quality of life.<sup>13</sup>

It is important to note that these issues are not only limited to the athletic world and that a substantial proportion of mental health problems in general are related to employment.<sup>34</sup> Employment and meaningful occupation is seen as an essential component of good health, areas where many of our fundamental psychological needs are met.<sup>32</sup> As such, people who experience redundancy or unemployment display a 50% increase in the risk of developing psychological problems in comparison to individuals in employment.<sup>33</sup> Although no comparison between mental health problems in athletes and people in general employment is currently available, Hughes and Leavey<sup>31</sup> argue that elite athletes are placed under a unique combination of stress factors which may compromise their well-being and therefore require more support from governing bodies. This problem is evidenced by Grove et al,<sup>9</sup> who reported that 20% of athletes experienced a distressing psychological reaction during the process of retirement. Furthermore, a recent *State of Sport Survey* in the UK reported that 50% of former athletes had concerns over their mental and emotional well-being and did not feel in control of their lives within two years of finishing their careers.<sup>28</sup> In response to this, a 'Mental Health and Elite Sport Action Plan' has been devised by the UK government, which requires all elite sport groups to have mental health procedures embedded in their performance plans by the year 2024.<sup>29</sup>

### **Effective strategies for athletes**

Not all athletes experience distressful reactions during their transition into retirement, but there are numerous potential problems for which athletes need to be made aware and prepared. Various strategies have been suggested in the literature in order to ease the elite athlete's transition into retirement. Lally et al<sup>6</sup> suggest investing time in other dimensions of athletes' identity by pursuing educational, social and occupational interests outside of the sporting world. This is consistent with recommendations by other studies,<sup>6,8,13</sup> which reported that athletes who decreased the prominence of their athletic identity and developed a new focus prior to retirement made smoother transitions.

Although support is extremely varied, depending on which country an athlete is from and which sport they competed in, it is recommended that athletes enquire within their respective sporting governing bodies as to whether they have a retirement transition programme.<sup>5</sup> Athletes may be able to undertake an end-of-career health consultation in order to enable self-management of any issues identified and also to gain an understanding of any career services on offer.<sup>4,8</sup> It is also advised that athletes should talk to other former athletes, team-mates and coaches about how they handled their transition into retirement.<sup>4,5</sup> In addition to this, many former athletes also use coaching as a way to stay involved with their previous sport and to maintain their social relationships.<sup>5,11,13</sup> For a variety of reasons, retiring athletes can feel a loss of social functioning, isolation and sometimes ostracism during the remaining time involved in sport prior to retirement. Therefore, it is important to encourage these athletes to start exploring and identifying a new focus, as well as encouraging the seeking of informational and emotional support inside and outside of the sport. Finally, athletes who are experiencing psychological difficulties during their transition into retirement can also seek interventions with a sport psychologist.<sup>30</sup>

### **Existing programmes**

Due to the issues discussed throughout this article, sporting governing bodies are beginning to increase the support they provide to athletes. This includes a range of services, from welfare staff being employed in organisations, career transition seminars and access to hardship and medical

grants.<sup>28,36,37,38</sup> UK Sport, the English Institute of Sport, the British Olympic Association and the British Paralympic Association all offer a collective programme called 'Athlete Futures', which provides career and lifestyle support to athletes. This programme began in September 2017 and is open to past and current members of UK Sport's World Class Programme, dating back to 1997.<sup>36</sup> The Professional Footballers Association (PFA) provides advice and support to members for a range of issues including the transition into retirement. Their services include paying 50% of the costs for accredited training courses to support the career development of its members. As well as this, the PFA also provide early access to pension funds and financial support during times of hardship or medical need.<sup>37</sup> A similar service is offered by the Rugby Players Association (RPA), where there is support available from personal development managers, who proactively work with players to prepare them for the transition into retirement. In addition to this, the RPA also have an open access helpline and support network for lifestyle-related issues including career transitions and mental health.

Finally, the Professional Cricketers' Association has six regional personal development managers who work full-time from academy level through to former players.<sup>40</sup> They provide support to players for a range of lifestyle-related issues and also host regular career transition seminars to help players recently leaving the game.

### Practical suggestions

- Educate athletes on the potential difficulties that may occur during the transition into retirement
- Encourage strategies to be developed that enable athletes to self-manage their previous injuries and lifestyle when they are outside of the high performance system
- Aim to increase understanding and discussion of these issues throughout the high performance team and through this to filter down for the benefit of athletes
- Raise awareness for governing bodies to improve the post-retirement support of athletes
- Encourage athletes to use their 'down-time' effectively during their careers, optimising the development of a broader range of social identities outside of sport, to provide a stronger social support network before and during retirement
- Encourage athletes to develop life skills and lifestyle management within sport organisations throughout their athletic career
- Find ways to keep previously retired athletes in the sport system, because of the knowledge and skillset that they have. Coaching and ad-hoc mentoring are viable options that sport organisations could fund.

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# Applying the concept of reflection to strength and conditioning

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## OVERVIEW

The aim of this narrative review is to define reflection and discuss how the characteristics of reflection apply to strength and conditioning. During this review, a novel definition will be proposed,<sup>1</sup> that clarifies what reflection is; this will then form the basis of recommendations for embedding reflection into the everyday practice of strength and conditioning. It is hoped that the proposed theoretical position will encourage further refinement from researchers and inspire enquiry to explore the neurocognitive processes involved in reflective thinking. This will facilitate the development of a comprehensive yet precise theory of reflection that aims to explain the neurocognitive process that will guide empirically oriented studies. Subsequently, a robust and empirically informed explanatory theory of reflection will be used to recommend practically amenable methods that encourage strength and conditioning coaches to think deeply, innovatively and creatively about their coaching practice.

## What is reflection and reflective practice?

Reflection, reflective learning and reflective practice are commonly used terms that lack coherency and explicit distinction due to the large number of definitions available.<sup>2-13</sup> Given this situation, it is currently difficult to recommend methods or guidelines to encourage reflection in the context of strength and conditioning. It is therefore important to be clear about what reflection is prior to developing interventions that aim to facilitate learning through reflection. Due to the multitude of varying definitions, the author performed a systematic review and thematic synthesis<sup>14</sup> on existing literature that explored the concept of reflection.<sup>1</sup> The aim of this systematic review was to understand the common themes between conceptual articles and to construct a definition that captures the mutually agreed

characteristics, thus contributing a unified definition of reflection to the existing literature. This approach adhered to the idea of intersubjective agreement proposed by Habermas,<sup>15</sup> whereby multiple individuals experiencing the same or similar subjective experience provide evidence for the validity and existence of a subjectively agreed characteristic.

The above mentioned systematic review synthesised 14 studies that have previously explored the concept of reflection, resulting in four analytical themes: cognitive, integrative, iterative and active.<sup>1</sup> These themes illustrate the shared characteristics of existing definitions and capture the overlap between conceptual interpretations, evidencing intersubjective agreement from 14 scholars over a period of 85 years from different countries and cultures.<sup>15</sup> Although this approach could not account

## 'Reflection (is a) cognitive process ... (used) to construct meaning from a puzzling experience and create an explanatory hypothesis for this'

for inter-interpretative bias [eg, perspectives being developed from prior definitions by adding layers of enquiry on an original thesis such as Dewey<sup>6</sup> or Schon<sup>16</sup>] these characteristics provide an integrated working definition of reflection.<sup>15</sup>

*Reflection is 'a careful examination and bringing together of ideas to create new insight through ongoing cycles of expression and re/evaluation'*<sup>1</sup>

The above definition characterises reflection as a cognitive process involved in bringing ideas together from multiple knowledge domains to construct meaning from a puzzling experience and create an explanatory hypothesis for this puzzling experience.<sup>1</sup> Thus, reflection clarifies ambiguity by bringing together information assimilated from direct experience with multiple domains of existing knowledge.<sup>1</sup> This is usually achieved by expressing an evolving line of enquiry in dialogue.<sup>1</sup> Specifically, the reflecting individual will express ideas symbolically [eg, written or verbally expressed language] to bring together existing domains of understanding into a narrative that explores hypotheses which aim to make sense of the experience. Typically, this leads to new insights and innovative perspectives and meaning, integrating previously discrete domain-specific schemas.<sup>1</sup>

The above definition positions reflection as a cognitive process that is facilitated by external expression usually in the form of writing.<sup>13,17</sup> This aligns with the original conceptualisation of Dewey,<sup>6</sup> who proposed a technical rationalistic form of reflection,<sup>18</sup> that was later theoretically developed by Schon<sup>16</sup> into a creative and practically relevant interpretation of reflection.<sup>18</sup>

As reflection is a cognitive process, the current author aims to further develop a neurophysiological theory of reflection by firstly utilising existing empirical data by synthesising a multitude of neuroimaging studies to develop a testable hypothesis that will then be empirically explored/validated.<sup>1</sup> The domain of cognitive semiotics is a pertinent field of enquiry to theoretically refine the proposed conceptualisation and develop a logical neurocognitive theory of reflection that can be empirically explored.<sup>1</sup>



Zlatev<sup>19</sup> defines cognitive semiotics as 'the study of meaning, mind and communication' through symbolism, making cognitive semiotics a relevant field of study that can enlighten enquiry into reflection due to external symbolic expression enabling a deeper cognitive process of enquiry.<sup>2,20</sup>

The person reflecting is by logic actively involved in learning as they are construing meaning, rather than being a mere passive recipient of knowledge and understanding. Therefore, the remainder of this article will explore the remaining two characteristics identified in the above thematic synthesis [integrative and iterative]; it will also provide practical examples of how these characteristics may materialise in the real world of strength and conditioning.

### The process of reflection

#### INTEGRATION

Learning is said to depend on individual efforts to understand ideas, requiring practitioners to link prior learning with new knowledge through reflection.<sup>21</sup> Consequently, effective learning is characterised by meaning transformation<sup>12</sup> and integration of information from a variety of meaning schemas through reflection.<sup>1,21</sup> Strength and conditioning coaches often coach in a rapidly changing environment with many constraints on practice (eg, time, finances, resources)

and are held accountable for the athletes' physical development. Frequent unexpected circumstances – such as athlete injury or tiredness and subsequent lack of engagement during periods of intense training – place demands on coaches to remain adaptable and open to learning from experience. Additionally, as coaching is not always an exact science, there is a need for creativity to be embraced within acceptable (and rather grey) boundaries. The common notion of the 'art of coaching' and 'art of using science' is pertinent to theories of reflection that explicate the artistry of professional practice, whereby practitioners deal with situations of uncertainty and instability.<sup>16</sup> Reflection and the bringing together of ideas has been likened to the analogy of a chef who uses his/her knowledge of ingredients to innovate and orchestrate novel recipes rather than using ready-made recipes.<sup>21,22</sup> Reflective practitioners use knowledge from scientific reading and investigations to develop practical and innovative solutions to real world problems.<sup>23</sup>

Gilbert and Trudel<sup>23</sup> have developed a model that can be used to demonstrate the place of reflection in problem-setting and solving. In this model, reflection is preceded by coaching issues and progresses through stages of issue setting, strategy generation, experimentation and evaluation. This is similar to experiential learning theory that begins with an experience and progresses through stages of reflective observation, abstract conceptualisation and active experimentation.<sup>11</sup>

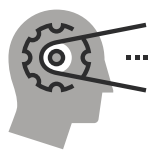
If these models of experiential learning are considered in the light of the current author's conceptualisation of reflection,<sup>1</sup> the resolution of real world coaching issues can be framed as one possible trigger to a reflective conversation. Subsequent explication of the problem through exploratory dialogue defines, delimits and constrains the reflective conversation to a focused exploration of the problem in context. Thus, reflection should define the issues through exploratory dialogue to begin to understand the issues prior to constructing hypothetical solutions.<sup>24</sup> It is worth noting that practitioners may not have assimilated new information during the process of reflection, but are able to use existing knowledge and ideas to construct novel insights and solutions to coaching issues.<sup>1</sup> Reflection thus brings together ideas to create new insight, enabling practitioners to use their existing knowledge to construct innovative resolutions to real world issues.

An example of knowledge integration through reflection is a coach who explores the reasons why a group of young athletes lack engagement with structured plyometric training, resulting in the coach bringing together ideas from three domains of understanding: motor learning in young athletes, the benefits of plyometric training in young athletes and youth engagement with game-like activities. In this example, the three domains may be explored in an evolving narrative that initially problematises the issues they have been experiencing to define, delimit and constrain dialogue onto the problem of interest. The coach will explicate the problem by constructing an evolving dialogue to understand the possible causes of low engagement.

The coach may subsequently bring together ideas from the three identified domains and begin developing hypothetical solutions (eg, the benefits of designing game-like scenarios to coach plyometric training). He or she may then develop a plan to implement a game-like scenario to coach this group and use this method in the subsequent training session. A game-focused method of coaching achieves the plyometric training benefits in young athletes while engaging the athletes using an external fun-focused and competitive activity. Thus the three domains – motor

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orchestrate  
novel recipes'**





learning [implicit learning with an external focus of attention] in young athletes playing games [youth engagement and the need for games to teach skills] to achieve the benefits of plyometric training – become integrated and may inspire the coach to explore alternative ways of coaching using implicit learning through game-like constraints. Thus, initial enquiry into three somewhat discretely organised schemas of understanding may lead to integration that furthermore leads to a change in perspective.

This example shows how reflection may facilitate novel and innovative coaching methods being used to engage young athletes, while remaining logical and well-reasoned within acceptable (and often rather grey) boundaries. Thus, strength and conditioning coaches are encouraged to reflect explicitly in writing and through coaching conversations to promote well-reasoned innovation and facilitate the ‘art of coaching’.

#### ITERATION

Iteration refers to the cyclic ‘looking back’ at what has been previously recorded in writing in order to re-evaluate and/or refresh previous lines of thought. This facilitates the ability to free up an individual’s working memory, so that attention can be placed on analytical and evaluative functions. As the individual initially reflects, they will be using divergent cognitive processes to express information in a more open and less restrictive manner.<sup>25,26</sup> Subsequent re-evaluation uses a closed focus of attention to analyse previous lines of thought and can bring alternative information into the dialogue to refine understanding.<sup>26</sup> As such, written and explicit ways of reflecting are considered more effective by the current author as written and explicit representation facilitates phases of

differentiated thinking<sup>26</sup> and enables the writer to carefully re-evaluate their ideas.

Coach engagement with reflection has been reported to be constrained by time.<sup>20,27</sup> Having identified time as a barrier to reflective practice in strength and conditioning coaches, Marshall<sup>28</sup> discussed the benefit of coaching conversations when aiming to encourage learning in time-sparse working environments. Although written forms of reflection facilitate deeper and more effective changes in perspective when reflecting individually,<sup>12</sup> verbally manifested reflection can lead to changes in perspective if the person reflecting is challenged or offered alternative views that were not previously considered.<sup>12,29</sup>

Therefore, coaches are encouraged to have conversations that aim to solve the problem areas of their practice; they are also encouraged to learn collaboratively as well as to engage with individual written reflection.

#### Conclusion

Reflection involves bringing together ideas to create insight by re-evaluating prior ways of thinking with the inclusion of new information into the reflective dialogue. Written reflections are easily re-read to facilitate re-evaluation, whereas coaching conversations can lead to changed perspective with the inclusion of other coaches’ insights and novel perspectives. Thus, coaches are advised to seek out innovative and well-reasoned solutions to real world problems through reflection, which is a perceivably effective way of managing uncertainty implicit in the notion of the ‘art of coaching’.





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Tony is a PhD researcher at the University of Hertfordshire. He is an Accredited strength and conditioning coach and sport scientist who is actively exploring the concept and process of reflection.



# UKSCA Professional Pathway: Further developments in 2019

There have been developments since we wrote about the introduction of new professional standards in the March issue. This article presents an update on the progress towards achieving the new professional 'S&C Coach' standard, together with progress on developing the chartered process for Accredited S&C coaches.

By **Chris Bishop**,  
*Chairman of the UKSCA  
Board of Directors*

## The S&C Coach

As outlined in the recent article in the March issue of the journal, the new professional standard of 'S&C Coach' is currently being developed with CIMSPA and employers. The S&C Coach will be a new membership level for the UKSCA and the entry criteria for membership will be based on endorsing courses, not individuals. Thus, higher education providers of qualifications such as undergraduate and postgraduate degrees will be able to map to these standards and, if they meet the requirements, will become a 'UKSCA Affiliate Training Provider: S&C Coach' and 'CIMSPA Employer Partner'.

Since the inception of the UKSCA and the rise in popularity of S&C, we have seen over 44 undergraduate and postgraduate degrees being launched in the UK (with more currently in development). To date, the UKSCA has had very little direct influence over the development of these courses. Although we know that many have mapped to the UKSCA Accredited S&C Coach competencies in their design, this is not currently and never has been formalised. In addition, although degrees are quality-assured through the use of internal and external examiners, there is currently no national or single-process quality assurance of the degrees; this lack of quality assurance applies to content, as well as areas such as base qualifications of the lecturers, the amount of practical time built into the course, equipment and/or facilities, etc. Equally, members working on degree programmes have frequently communicated that they would like to make changes to improve their offering, from better facilities

to more coaching practical time, but often face institution restrictions (eg, budgets, staff, space, etc). Through putting in place standards against which degrees can be measured, the UKSCA and CIMSPA's independent quality assurance process can start to positively influence how degrees are run in line with best practice, noting that HE institutions and employers are all involved in the creation of these standards.

## NEXT STEPS

The UKSCA and CIMSPA have already involved employers and members in the development of the first draft of the standard for S&C Coach, but wider involvement of the profession is now vital. It is important that we hear your views and requirements and we will do this through an Internet-based consultation. The second draft of the standard was re-submitted to CIMSPA on June 11, with the membership consultation process due to take place from July 12-26.

## The chartered process for Accredited S&C Coaches (Chartered Coach and Chartered Fellow)

While the details of CIMSPA's requirements for Chartered Coach are still being agreed by the Privy Council (who grant Royal Charters on behalf of the Queen), the UKSCA is starting work on additional requirements, which will make the process specific to S&C. As per our article in the March issue of PSCJ, coaches who have successfully completed the accreditation will retain their ASCC status and be eligible for Chartered membership through CIMSPA once the process is complete.

Our vision is simple: we want to build a process that retains the current ASCC/competency-based assessment, but also addresses the identified needs of employers who are now looking for standards that cover more expertise-based assessment of individuals. We have recently created a project team and employed a consultant to provide an independent audit of current processes and work with us to advise on areas where we can start to build in more expertise-based assessment for the profession. In due course, we will produce a draft of a new assessment model, and we will be talking to employers and members through face-to-face and remote consultations to help shape this further. It is critical that this new assessment model meets the needs of employers and members, to ensure that this drives the right development and education activities of the profession for the future. In addition, the intention is for part of this process to develop a model of 'supervised practice', which supports the development of the new graduate 'S&C Coach' towards becoming 'Accredited', thus providing a more sustainable pathway for early-career coaches.

There is nothing at the moment to stop individuals signing up for their UKSCA ASCC assessment with only a few weeks of real coaching experience with one or two athletes; however, this lack of experience is reflected in what assessors are currently seeing during assessment days. Our aim

is to shift the expectation that the ASCC assessment is something that is attempted immediately upon graduation; instead it is to become something that is typically completed after real-life work experience and coaching hours have been accrued over time. Furthermore, this coaching experience will enable early-career coaches the opportunity to develop skills relating to reflective practice, a process that naturally feeds in to the chartered process as well.

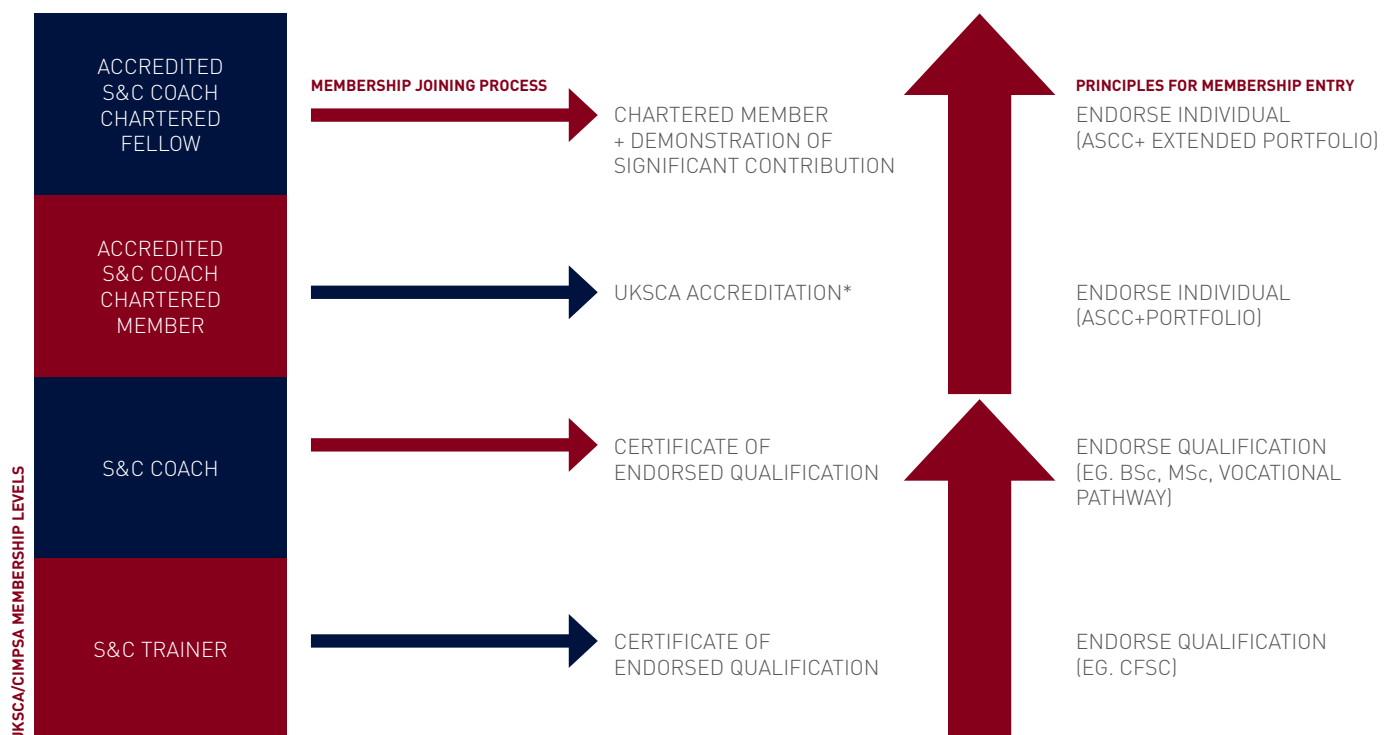
#### NEXT STEPS

Over the summer we will be developing the 'beefed up' Accreditation model in line with this chartered application process, and this draft will be widely distributed for consultation. At this point, we are unable to make specific plans for the timing of this as it needs to coincide with the Privy Council's agreement of CIMSPA's changes to their Royal Charter. However, we are starting work now; as soon as those changes are agreed, we will be in the best position to move this forward. We will also outline how current Accredited members can become Chartered once all these details are agreed. At the moment, we are exploring ways in which our existing CPD re-accreditation model can be aligned to meet this need.

If you have any questions, please do not hesitate to contact me at [chris@uksca.org.uk](mailto:chris@uksca.org.uk) and we look forward to your involvement in shaping the S&C profession in the UK.

**Figure 1.** UKSCA/CIMSPA proposed model for the progression of S&C qualifications in the UK.

\* means that chartered membership can be applied for once UKSCA accreditation is completed with accompanying documented evidence (in the form of a portfolio)



# A comparison of maximal aerobic speed and maximal sprint speed in elite youth soccer players

By **Adam Rowan**,<sup>1,2</sup> **Steve Atkins**<sup>1</sup> and **Paul Comfort**<sup>1,3</sup>

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## Introduction

Soccer is a sport that is intermittent in nature, involving running at a variety of speeds, with multiple changes of direction, while carrying out technical and tactical skills under conditions of game pressure.<sup>1</sup> Success in this sport demands a highly developed combination of both anaerobic and aerobic fitness qualities.<sup>32,35</sup> It is estimated that 90% of the total energy cost during a soccer match is provided by aerobic metabolism,<sup>3</sup> with international players displaying maximal oxygen uptake ( $\text{VO}_{2\text{max}}$ ) values between 55 and 68  $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ .<sup>33</sup> Aerobic fitness is a determining factor in an athlete's ability to recover between high intensity efforts and thus delay the onset of fatigue.<sup>38</sup> During a game, players are required to perform multiple sprints and high intensity efforts with minimal recovery,<sup>13</sup> with a greater number of sprints and high intensity efforts increasing at higher levels of competition,<sup>4</sup> which are also associated with higher levels of aerobic fitness.<sup>17,18,27</sup>

It is well established that improving aerobic fitness can increase the physical performance capacities in soccer players.<sup>17,19,27</sup> This improved fitness may allow players to make better technical

## OVERVIEW

The aim of this study was to compare maximal aerobic speed (MAS) and maximum sprint speed (MSS), across age groups and maturational status, in youth soccer players. Elite youth soccer players ( $n = 47$ ; age  $14.1 \pm 1.2$  years, with an age from peak height velocity  $0.6 \pm 1.3$  years; stature  $168.2 \pm 11.3$  cm; body mass  $57 \pm 11.7$  kg), performed MAS and MSS tests. The U16 age group demonstrated significantly greater MAS ( $4.61 \pm 0.23 \text{ m}\cdot\text{s}^{-1}$ ) than U13 ( $p < 0.001$ ,  $4.08 \pm 0.29 \text{ m}\cdot\text{s}^{-1}$ ) and U14 ( $p < 0.001$ ,  $4.14 \pm 0.26 \text{ m}\cdot\text{s}^{-1}$ ), although not significantly different than U15 ( $p > 0.05$ ,  $4.38 \pm 0.26 \text{ m}\cdot\text{s}^{-1}$ ). Similarly, MSS increased with chronological age, with the U16 demonstrating significantly greater MSS ( $8.43 \pm 0.43 \text{ m}\cdot\text{s}^{-1}$ ) than U13 ( $p < 0.001$ ,  $7.13 \pm 0.34 \text{ m}\cdot\text{s}^{-1}$ ) and U14 ( $p < 0.001$ ,  $7.68 \pm 0.45 \text{ m}\cdot\text{s}^{-1}$ ), but not significantly greater than the U15 ( $p > 0.05$ ,  $7.96 \pm 0.26 \text{ m}\cdot\text{s}^{-1}$ ). Maturational status showed players post age at peak height velocity (APHV) demonstrated significantly greater ( $p < 0.001$ ) MAS and MSS circum-APHV and pre-APHV. The results of this study demonstrate that both MAS and MSS increase progressively with chronological age and maturational status.

and tactical choices under fatiguing conditions.<sup>17</sup> Match analyses also highlight the importance of sprinting. Therefore, it would seem evident that the development of aerobic capacity and sprint speed is important for soccer players; elite youth soccer players for example, cover  $6549 \pm 597$  m to  $8312 \pm 1054$  m, including  $186 \pm 92$  m to  $384 \pm 163$  m of sprinting ( $>5.3 \text{ m}\cdot\text{s}^{-1}$ ) for U13s and U16s players, respectively.<sup>10</sup>

The assessment of physical qualities required to play high-level professional soccer is in the interest of most professional soccer academies,<sup>34</sup> in order to improve talent identification and long-term athlete development. During the early stages of adolescence, youth soccer players within the same chronological age group often present large variations in maturity.<sup>23,24</sup> This frequently impacts on physical

tests such as aerobic capacity and sprint speed, with the more mature players generally outperforming their less mature teammates.<sup>14</sup> Within a single age group, differences in sprinting performance as large as ~20% have been observed between more and less developed soccer players, based on biological maturation.<sup>25</sup> Similarly, metabolic response to endurance exercise in young athletes has been shown to differ according to their chronological age and biological maturation.<sup>26</sup>

Research findings demonstrate that maximal aerobic speed (MAS), which is defined as 'the minimal running velocity at which  $\dot{V}O_{2max}$  occurs',<sup>6</sup> generally increases with age, with an U14 age group showing values of 4.11 m.s<sup>-1</sup>, rising to 4.55 m.s<sup>-1</sup> at under U16.<sup>16,37</sup> In elite adult players, values of 4.91 m.s<sup>-1</sup> have been reported.<sup>2</sup> An increase was also shown when classifying players by maturity status, with older players (post-peak height velocity [PHV]) generally outperforming those who are less mature.<sup>11,28</sup>

Speed is a much desired characteristic that has been related to successful soccer performance.<sup>34</sup> To evaluate the running speed capacities in soccer players, a common practice is to assess their maximal sprint speed (MSS).<sup>11</sup> An advantage of assessing MSS is that it can be compared with MAS to show the overall locomotor and energetic profile of aerobic and anaerobic qualities of the athlete.<sup>28</sup> Throughout childhood, the development of speed is influenced by numerous anatomical, physiological, mechanical and motor control factors.<sup>15,21</sup> Philippaerts et al<sup>31</sup> reported that, in youth soccer players, sprint performance was impaired

12 months prior to PHV. However, the same study showed the greatest improvements in sprinting speed were displayed circum-APHV and continued to improve after PHV, but at a slower rate.<sup>31</sup> Further research shows that sprint times generally increase linearly with age,<sup>9,39</sup> with Williams et al<sup>39</sup> finding that the largest decrease in sprint time occurred when a player progressed from the U15 to the U16 age group ( $-2.55 \pm 2.30\%$ ). Likewise, for maturity status, players' post-APHV outperformed their less mature counterparts.<sup>9,28</sup>

The aim of this study was to compare MAS and MSS between the U13 to U16 age groups via both chronological age and maturational status in elite youth soccer players. It was hypothesised that MAS and MSS would increase with chronological age and maturation, in line with previous findings.

## Methods

### EXPERIMENTAL APPROACH

This study used a cross-sectional design to investigate the differences in MAS and MSS between elite youth soccer players of different age groups (U13 to U16) and maturational status (pre-PHV, circum-PHV and post-PHV). The 40m sprint was used to assess MSS,<sup>11</sup> whereas the 1500m continuous maximal running test was selected to determine MAS.<sup>5</sup>

### PARTICIPANTS

Elite male youth soccer players from a premiership academy volunteered to participate in the study (detailed participant characteristics are provided in Table 1). The study was performed at an elite Category One football academy and formed part of their prescribed

training load. All players were classified as competitive elite according to the taxonomy proposed by Swann et al.<sup>36</sup> All participants completed five football sessions (each lasting ~90 minutes) and one competitive game per week. Each team participated in two strength training sessions, and three to four 15-minute speed and agility sessions per week. Ethical approval was granted by the Institutional Review Board and conformed to the standards ascribed by the Declaration of Helsinki. Parental assent and participant consent were obtained prior to participation in this study.

### PROCEDURES

On arrival, participants had their stature assessed using a free-standing Stadiometer (Seca, Birmingham, UK). Seated height was measured using a free-standing sitting height table (Seca, Birmingham, UK). Body mass was assessed using digital scales (Seca Model 803, Birmingham, UK). The APHV was used as a relative indicator of somatic maturity representing the time of maximum growth in stature during adolescence.<sup>30</sup> Biological maturity age (years) was calculated by subtracting the chronological age at the time of measurement from the chronological age at peak height velocity. Players were subdivided into three maturational groups slightly adjusted to the study by Mendez-Villanueva et al,<sup>28</sup> which was: pre-PHV players (< -1 years to PHV; n = 6), circum-PHV players (> -1 year to PHV to < +1 year from PHV; n = 21) and post-PHV players (> +1 year from PHV; n = 20).

### WARM-UP

Prior to the MSS and the MAS test, a 10-minute standardised warm-up was completed, consisting of dynamic

**Table 1. Participant anthropometrics for each age group and maturation groups**

|            | PARTICIPANTS | AGE (YEARS) | YEARS FROM PHV | WEIGHT (KG) | HEIGHT (CM)  |
|------------|--------------|-------------|----------------|-------------|--------------|
| Overall    | 47           | 14.1 ± 1.2  | 0.6 ± 1.3      | 57.0 ± 11.7 | 168.2 ± 11.3 |
| U16        | 12           | 16.0 ± 0.4  | 2.2 ± 0.4      | 68.4 ± 6.7  | 178.2 ± 6.1  |
| U15        | 9            | 15.0 ± 0.3  | 1.2 ± 0.4      | 61.1 ± 5.8  | 172.8 ± 5.9  |
| U14        | 15           | 13.9 ± 0.1  | 0.1 ± 0.7      | 55.7 ± 10.1 | 166.3 ± 10.6 |
| U13        | 11           | 13.0 ± 0.3  | -1.1 ± 0.4     | 43.0 ± 5.0  | 156.0 ± 7.1  |
| Pre PHV    | 6            | 12.8 ± 0.2  | -1.4 ± 0.3     | 39.5 ± 3.6  | 151.0 ± 4.9  |
| Circum PHV | 21           | 13.8 ± 0.6  | -0.1 ± 0.7     | 53.2 ± 9.0  | 164.8 ± 8.8  |
| Post PHV   | 20           | 15.6 ± 0.6  | 1.9 ± 0.6      | 66.2 ± 6.5  | 176.8 ± 6.1  |

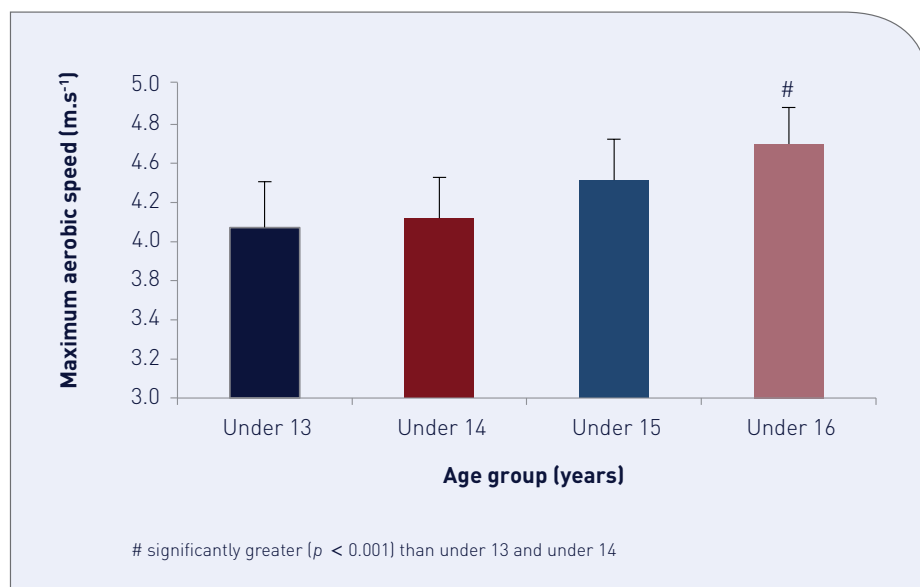


Figure 1. Comparison of MAS across age groups

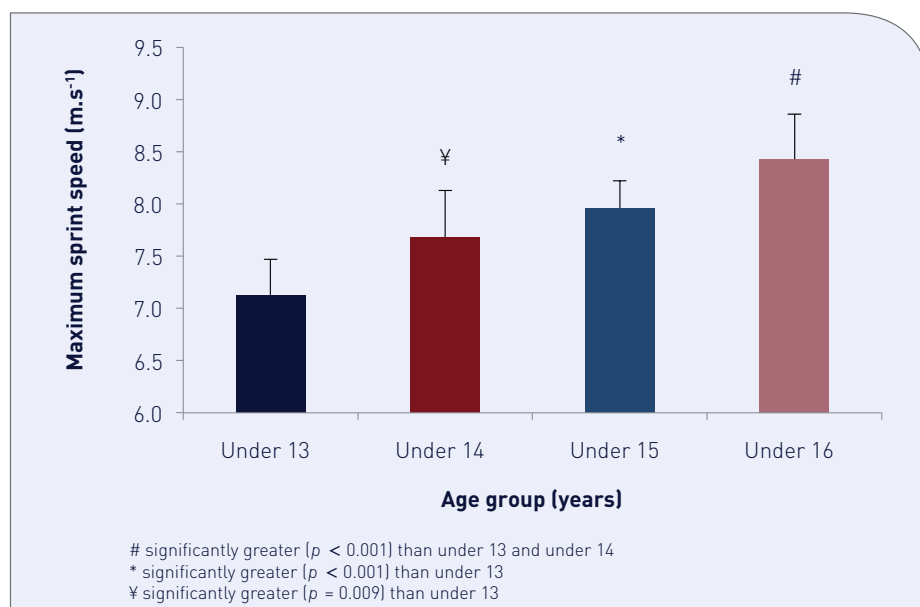


Figure 2. Comparison of MSS between age groups

mobilisation exercises undertaken at 60-80% of perceived maximal effort.

#### MAXIMAL SPRINT SPEED (MSS)

All players performed two maximal 40 m sprints on third-generation artificial rubber crumb surface (AstroTurf), using portable electronic dual-beam timing gates (The TC-System, Brower timing systems, USA). The 10 m split time between 30 m and 40 m was also recorded. There were three sets of timing gates placed at the start line, at 30 m and at 40 m and set at a height of one metre. Players were instructed to sprint as quickly as possible along the 40 m distance from

a two-point standing start, one metre away from the start timing gate. MSS was defined as the fastest 10 m split time (30-40 m) measured during a maximal 40 m sprint.<sup>11</sup> To allow adequate recovery, participants had three minutes rest between sprint trials. Sprint times were measured to the nearest 0.01 s. The best performance from the two trials was used for analysis. The reliability of the MSS has previously been reported as high.<sup>8</sup>

#### MAXIMAL AEROBIC SPEED (MAS)

Once the MSS was completed, the participants performed the MAS test. Participants were instructed to run

around the perimeter of the AstroTurf, for a set distance of 1500 m measured by a roller wheel, in the fastest time possible.<sup>7</sup> Timing was started once a whistle was blown to indicate the start of the test. Once the participant had crossed the finish line their time was recorded. Time was measured to the nearest second. MAS was calculated by dividing the time (seconds) to complete the distance by 1500. The distance of 1500 m was selected as Lacour et al<sup>20</sup> showed a high correlation ( $r = 0.90$ ) with the Université de Montreal Track-Test. Pre-study reliability testing showed ICC = 0.91, CV = 2.26% for the 1500 m MAS test.

#### STATISTICAL ANALYSES

All statistical analyses were conducted using SPSS software (version 20.0: SPSS, Inc., Chicago, IL, USA) and the *a priori* level of significance was set at  $p < 0.05$ . Normality of distribution was assessed using a Shapiro Wilk's test. If the data were not normally distributed, Friedman's test was performed to identify differences between groups, followed by a multiple Wilcoxon test with a Bonferroni correction. If data were normally distributed, one-way analysis of variance tests was conducted to determine differences between groups. Bonferroni post-hoc tests were then used to assess where those differences occurred. To determine the magnitude of difference between tests, Cohen's *d* effect sizes were calculated. Magnitude of effect was interpreted using the following criteria: 0-0.19, trivial; 0.2-0.49, small; 0.50-0.79, medium;  $\geq 0.80$  large.<sup>12</sup>

#### Results

Large and significant differences in MAS were observed across age groups ( $p < 0.001$ ), with U16s significantly higher ( $4.61 \pm 0.23$  m.s<sup>-1</sup>) than U13s ( $4.08 \pm 0.29$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 2.03$ ) and U14s ( $4.14 \pm 0.26$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 1.91$ ), although not significantly greater than the U15 ( $4.38 \pm 0.26$  m.s<sup>-1</sup>,  $p > 0.05$ ,  $d = 0.42$ ) (see Figure 1). No other significant or meaningful differences in MAS were observed between age groups ( $p > 0.05$ ).

There were large and significant differences ( $p < 0.001$ ) in MSS across age groups, with U16s demonstrating significantly quicker MSS ( $8.43 \pm 0.43$

m.s<sup>-1</sup>) than the U13s ( $7.13 \pm 0.34$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 3.35$ ) and the U14s ( $7.68 \pm 0.45$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 1.70$ ), although not significantly greater than the U15s ( $7.96 \pm 0.26$  m.s<sup>-1</sup>,  $p > 0.05$ ,  $d = 2.74$ ) (Figure 2). The U15s showed a significantly greater MSS than the U13's ( $p < 0.001$ ,  $d = 2.17$ ), although this was not significantly greater than the U14s ( $p > 0.05$ ,  $d = 0.76$ ). The U14s also showed a significantly greater MSS than the U13s ( $p < 0.009$ ,  $d = 1.38$ ).

A significant difference ( $p < 0.001$ ) in MAS was also observed across different maturation status, with highest MAS post-PHV ( $4.51 \pm 0.26$  m.s<sup>-1</sup>) which was significantly greater than MAS circum-PHV ( $4.16 \pm 0.27$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 1.32$ ) and pre-PHV ( $4.04 \pm 0.37$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 1.94$ ) (Figure 3). No other significant differences ( $p > 0.05$ ,  $d = 0.48$ ) in MAS were observed between maturation groups.

The results of Friedman's test showed a significant difference ( $p < 0.001$ ) in MSS across different maturation groups. Subsequent Wilcoxon post-hoc analysis, with Bonferonni correction, revealed that the highest MSS occurred in the post-PHV group ( $8.26 \pm 0.41$  m.s<sup>-1</sup>) which was significantly greater than circum-PHV ( $7.56 \pm 0.46$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 1.61$ ), and the pre-PHV ( $7.09 \pm 0.42$  m.s<sup>-1</sup>,  $p < 0.001$ ,  $d = 2.82$ ). The magnitude of the effect size was very large (Figure 4). No other significant differences ( $p > 0.05$ ,  $d = 1.07$ ) in MSS were observed between maturation groups.

## Discussion

In line with our hypotheses, the results of the present study showed that MAS and MSS increased with both chronological age and maturation status. MAS increased progressively with age, where the U16s reported the highest MAS and these results were significantly greater than the U13s and the U14s. MSS also showed a progressive increase with age, where the highest MSS was in the U16 group, demonstrating a significant and large difference compared to the U14 and U13 age groups. When grouped by maturational status, MAS performances of players post-APHV demonstrated significantly greater MAS than circum-PHV and pre-PHV. Furthermore, the results indicate that MSS increases progressively with the player's stage of

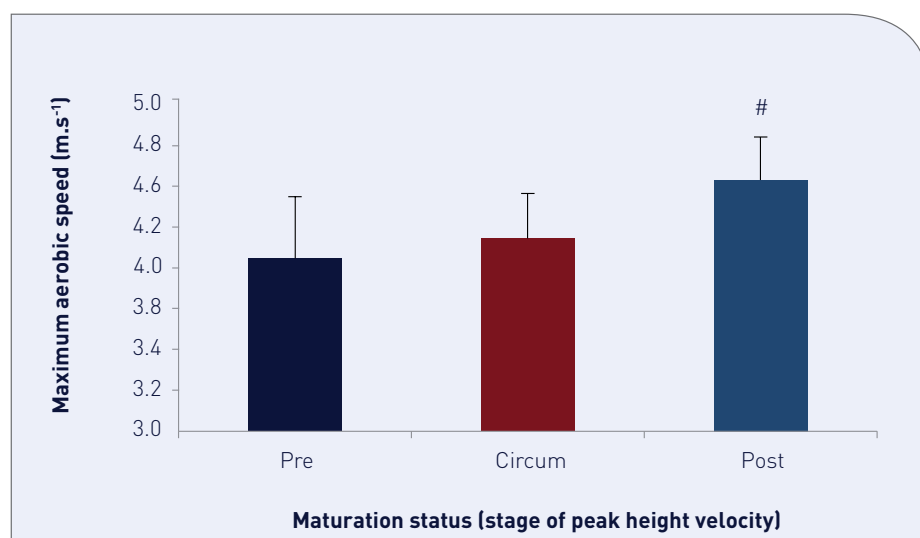


Figure 3. A comparison of MAS across stages of maturation

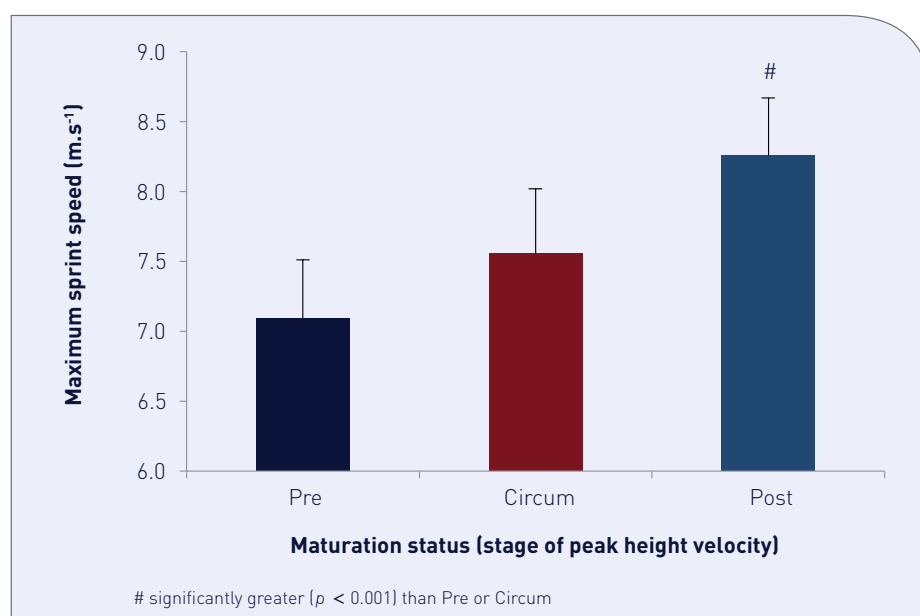


Figure 4. A comparison of MSS across stages of maturation

maturation, with players' post-APHV performance significantly greater than either the circum-APHV or the pre-APHV performance.

When comparing MAS by age, the U16s in this study were slightly higher than those reported by González-Badillo et al<sup>16</sup> in Spanish U16 players ( $4.5$  m.s<sup>-1</sup>), and the same as U16 Brazilian players ( $4.6$  m.s<sup>-1</sup>).<sup>37</sup> As expected, the highest MAS values for the U16s on average were some way off elite Italian professional players ( $4.9$  m.s<sup>-1</sup>); however, this potentially shows the level of aerobic capacity required to play at an elite level.<sup>2</sup>

The results of MSS with age in this study were in line with previous research in an elite premiership academy.<sup>39</sup> Williams et al<sup>39</sup> also showed a decrease in sprint times (2.55%) between the U16 and U15 age groups, with the smallest worthwhile effect for a change in performance calculated at 1%. However, when comparing the results from Williams et al<sup>39</sup> to the present study, there were no differences between the U15 and U16 age groups. This could be explained by the fact that all the players in the U16 group were post-APHV, compared with the U15 who had only two players circum-APHV, therefore potentially highlighting the fact that

players in each group were similar in terms of physical development.

When comparing MAS by maturational status, the results of this study support the hypothesis and were similar to previous findings, suggesting that MAS and MSS are greater for more mature players.<sup>28</sup> These results are expected as, when a player is maturing, changes in the cardiorespiratory and musculoskeletal systems naturally occur. However, it would have been expected that players who are reaching PHV (circum-APHV) would have shown a significantly greater MAS than pre-APHV.

Philippaerts et al<sup>31</sup> found significant natural gains in aerobic endurance around the time of PHV; however, in the current study although there were improvements, these were not significant, which could be explained by the potential error associated with the somatic equation used. Malina et al<sup>22</sup> suggested that a maturity offset protocol, applied to youth soccer players, may result in prediction errors of up to one year; therefore, it is worth noting that some caution should be taken regarding the accuracy of the moment of PHV.<sup>29</sup>

When comparing MSS by maturational status, the results of this study were similar to previous findings.<sup>28,31</sup> It is likely therefore, that improvements in MSS result from increases such as limb length, cross-sectional area of the

muscle, and metabolic and biological changes;<sup>15,21</sup> however, as mentioned previously, some caution should be taken regarding the accuracy of the moment of PHV.<sup>29</sup>

In addition to growth and maturation-related changes, improvements in MSS and MAS may also result from exposure to strength and conditioning training interventions. It is hard to tell in this study if that is the case, as there has been no targeted intervention to try and improve MAS or MSS, compared to a matched control group. Therefore, further research would be interesting to investigate if a conditioning block of six weeks running prior to training more greatly enhanced a player's MAS, when compared to football specific games (SSGs) alone.

A further limitation of this study is the relatively small sample size for a cross-sectional study and, due to the elite level of the subjects, they are a homogenous group with a higher likelihood that more physically able players would be selected, which may have affected these results; therefore, it is suggested that future studies recruit more heterogeneous groups with larger samples and greater variation in maturity status. Nevertheless, the current study is unique in assessing physical properties of elite youth soccer players: access to such populations can be challenging; however, this does lead to greater utility in elite sports performance.

## Practical application

This study has demonstrated that simple practical field tests such as the MAS and MSS can be used to determine important fitness characteristics associated with playing high level soccer without going to a laboratory. However, it is important for the strength and conditioning coach to consider the maturation status of the athlete when interpreting fitness data such as MAS and MSS, as players within the same age group can often display large variations in maturity.

Moreover, rather than just looking at MAS and MSS alone, it may be useful to combine the two results to work out each player's anaerobic speed reserve (ASR). This will help the strength and conditioning coach to build profiles of athletes based on their mechanical limits, supported by their metabolic systems (aerobic and anaerobic). Furthermore, this will allow running-based sessions to target what athletes need to prioritise; for example, a player with a low MAS but high MSS would likely benefit from improving their MAS, allowing them to recover more quickly between high intensity and sprint bouts in a game. In contrast, a player with a high MAS but low MSS may benefit more from maximal sprint and repeated sprint training.

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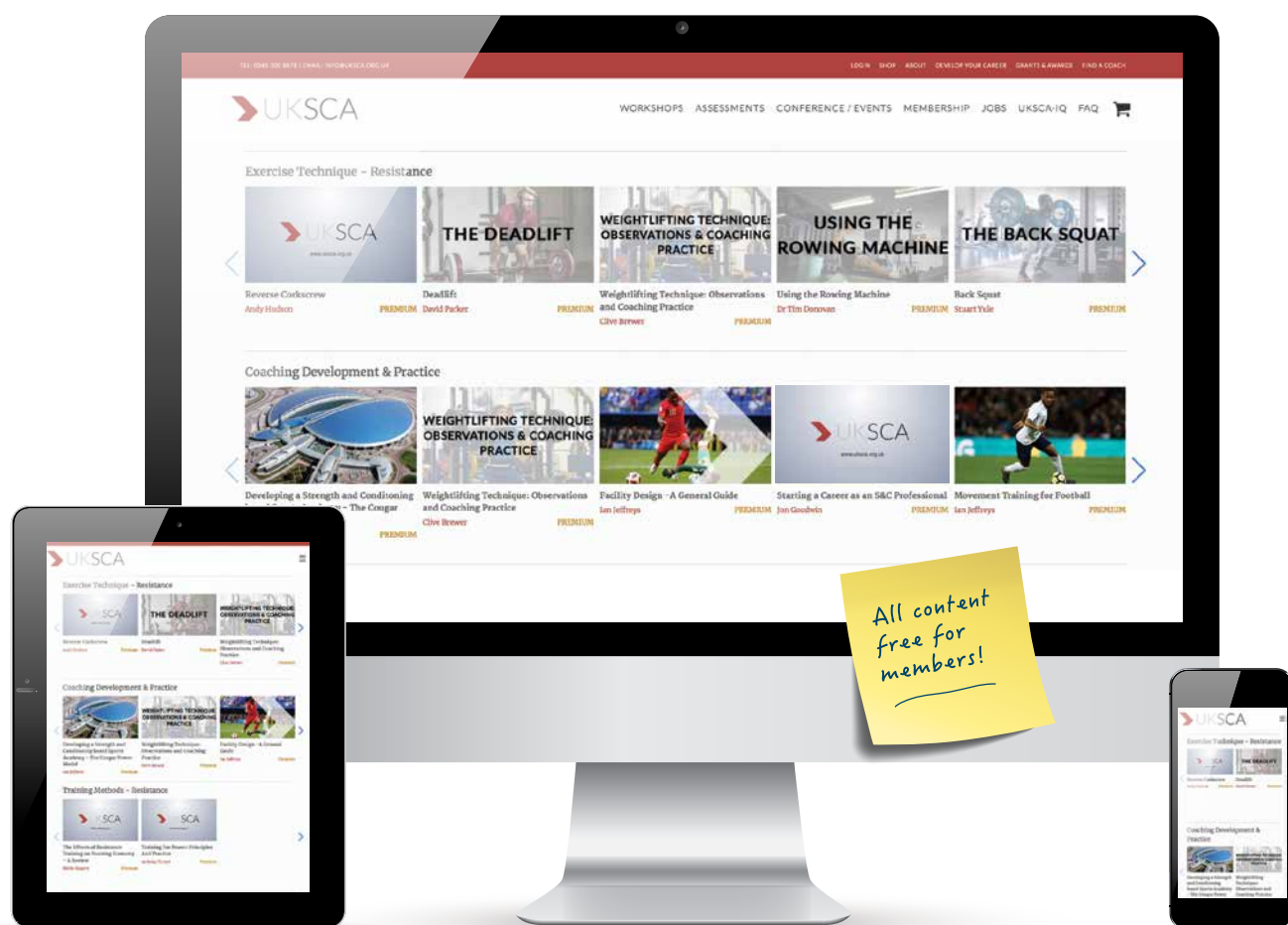
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