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THE TACTICAL ATHLETE

RAMP WARM-UP SYSTEM

STRONGMAN TRAINING

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.

25 Mar 2017 – Forthbank, Stirling

26 Mar 2017 – Forthbank, Stirling

01 Apr 2017 – Loughborough University

29 Apr 2017 – Manchester Institute of Health & Performance

30 Apr 2017 – Manchester Institute of Health & Performance

20 May 2017 – St Mary's, Twickenham

21 May 2017 – St Mary's, Twickenham

17 Jun 2017 – Loughborough University

15 Jul 2017 – Manchester Institute of Health and Performance

16 Jul 2017 – Manchester Institute of Health and Performance

12 Aug 2017 – St Mary's, Twickenham

13 Aug 2017 – St Mary's, Twickenham

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The UK Strength & Conditioning Association

Contents

How does the 'truly efficient laborer' work?

It is said that experience is a great teacher. In our quest to master the profession of strength and conditioning, undoubtedly gaining experience is a crucial component, and aspiring coaches are typically advised to get as much experience as possible. However, is this always the right advice? For, ironically, a danger lies in the quest to cram in as much experience as possible, as this removes a critical component of our effectiveness: 'slack' or free time. At an individual and organisational level, there is often a tendency to ensure we are busy, making all of our time as 'productive' as possible by filling our schedules – however, this tendency may well reduce our long-term productivity and development.

Recently, I was fortunate to spend some time in Athens, and to trace the footsteps of some of history's greatest philosophers. The story of Archimedes and his famous Eureka moment in the bathtub came to mind. Here the solution to a problem came not at a time of deep concentration and study – but instead at a time of relaxation.

This tendency to great insights at unusual times has frequently been reported and one concept contributing to this is 'bandwidth'. The human mind only has a limited capacity – its mental bandwidth – to focus on tasks; the more of its 'bandwidth' is allocated to one challenge, the less is available for other tasks. When burdened with several challenges, the mind will tend to focus on what it considers the most important and that tends to be what has the greatest short-term impact: a process termed 'hyperbolic discounting', or present bias.

It is here, that the realities of the work environment, and its 'vortex' of pressing issues can become a great challenge to learning from experience. To cope with the vortex, and its myriad of short-term pressures, the mind tends to tunnel, focusing on tasks which appear to be the most urgent: getting ready for the upcoming session, getting reports written, replying to emails etc. This often results in a constant juggling of short-term issues, moving from one pressing task to the next with little thought about other matters. Thus, tunnelling – despite potentially increasing short-term productivity – has an inherent cost: activities not pressing in the short term, but potentially critical in the long term, tend to be sidelined – a form of tax on the future. Slack in a schedule will therefore allow time to deal with these matters.

'having slack in our schedule is not a luxury but an important developmental strategy'

The concept of available bandwidth, and the need for slack to maximise this, is an important element in evaluating the potential of experience to be a true learning one. Critically, it is not experience per se that is important, but rather the learning that comes from it: we must not confuse the knowledge that comes from experience with frequency of activity. Effective experience requires the ability to see how theories and methods manifest themselves in practice. It involves experimenting with different applications, identifying connections and contradictions and critically identifying optimal solutions to varying tasks and challenges. This develops a deeper understanding of the training process and the challenges of executing this in a given environment. Critical to this is the ability to reflect on and analyse the entire process, which requires dedicated time. If there is no slack, short-term priorities will dominate: effectively, you sacrifice future growth at the altar of short-term efficiency.

It is important that we are aware of the work vortex's potential to derail our long-term development. How often have we finished a day's work – having been really busy – and yet on reflection been unable to pinpoint any real achievement? Similarly, how often have we returned from a workshop ready to instigate a new way of training, but ultimately been dragged back into the work vortex, with no time to introduce this new method which eventually retreats to the back of our mind – just another thing we 'planned to do'.

Thus, having slack in our schedule is not a luxury but an important developmental strategy. We need to carefully choose our activities and protect our slack to ensure that our developmental activities take place. Although this may often lie outside our direct control, an awareness of this can help to identify potential times which we could use better.

Many enlightened organisations understand this need for slack and bandwidth, and have systems in place to encourage this. For example, 3M famously allows its employees 15% of their time to work on topics that interest them. Importantly, this 'slack', far from reducing productivity, has actually resulted in some of the company's most famous products, earning them millions of dollars.

The words of American author/philosopher Henry David Thoreau may hold the clue to finding this efficiency and effectiveness: 'the truly efficient laborer will be found not to crowd his day with work, but will saunter to his task surrounded by a wide halo of ease and leisure'.

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

NEWS

Annual Conference 2017 4–6 August

This year's annual conference will again be held at the Jurys Inn, Hinckley Island, Leicestershire, from 5–6 August. We will also be running pre-conference sessions on Friday 4 August.

At the time of going to press, we have confirmed the following speakers and the full programme will be available on the website soon:

- **William Kraemer** PhD, FNSCA, FACSM, FISSN, professor of kinesiology, Ohio State University, USA
- **Loren Landow**, biomechanics specialist from the US NFL
- **Matt Little**, ASCC, S&C coach to Andy Murray
- **Des Ryan**, ASCC, head of sports medicine and athletic development, Arsenal FC Academy
- **Dr Jonathan Folland**, reader in human performance and neuromuscular physiology, Loughborough University.

UKSCA recruiting ...

We are looking to expand the UKSCA Tutor pool that runs our regular workshop programme across the UK. If you have at least seven years of experience, are able to commit to the UKSCA's tutor training pathway (see below), and would like to become a tutor on at least two of our five workshops, then we would like to receive your application by 21 April 2017.

The five workshops we currently run are: foundation; applied coaching science; weightlifting; plyometrics, agility and speed; and planning effective programmes.

The UKSCA's tutor training pathway is as follows:

- A one-day 'Principles of teaching and learning' course
- Orientation days for each of our workshops (you do not need to complete all the orientation days before the next step)
- Working as an assistant tutor before being signed off to become a UKSCA tutor.

Tutors are also expected to contribute to the ongoing development of our workshop programmes and to engage with ongoing tutor training events.

UKSCA 'Internship' grants

Applications are now welcome from clubs (and organisations) looking for support in developing their early career coaches/interns.

Successful clubs/organisations will receive grants of up to £1250 to be spent on UKSCA workshop places, which will form part of the structured development of their staff. In order to qualify, the applicant club will need to show that they are committed to developing their staff; furthermore, throughout the period of the grant, they will need to demonstrate that they are continuing to embed best practices into their programmes on an on-going basis.

Through raising awareness of 'what good looks like' and encouraging and rewarding good practice, the UKSCA is aiming to make a meaningful impact on the quality of these programmes across the UK, supporting employers and coaches at the same time.

Full details of the application process can now be found in the Grants section of our website.

CHAIRMAN'S COLUMN

Pete McKnight

This journal sees the announcement of a new UKSCA grants fund (see news story on page 5), aimed at employers who are looking to support the development of their early-career coaches or interns. This is a really exciting move, as we hope, through this initiative, to have a positive and lasting impact on the quality of internship programmes across the UK.

To begin with, the grants will be in the form of free places on UKSCA workshops; however, we have also had initial conversations about ways in which we can team up with National Governing Bodies to expand this concept, offering a broader range of support and education: for example, sports-specific coaching qualifications for S&C coaches.

Running alongside this, we will also be adding a new category to our annual awards, which will culminate at the conference gala dinner on August 5 this year. This new award – the S&C Employer of the Year – Coach Development – will recognise employers who have gone the extra mile towards supporting the development of their staff; and so we look forward to spreading some positive news about those clubs and organisations who have been working hard to invest time in developing their S&C coaches.

I have also been pleased to hear about the success of the pilot of our new workshop – Applied Coaching Science – and, on behalf of the Association, I would like to thank the project team who have spent many hours pulling this together. The feedback from the pilot group has been very positive – and it seems that coaches at every level would benefit from attending as there is nothing else out there at the moment that delivers this type of content. At the time of writing there were a couple of places left on the first workshop on April 8–9, in Manchester, and I know that I myself and other Board members are keen to book our places soon!

Pete McKnight
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NEWS

Annual General Meeting (AGM)

All members are welcome at this year's AGM which will be held at 18.00 on 5 August 2017 at the Jurys Inn, Hinckley Island, Leicestershire. The AGM will be concerned with the annual report of the Association, including the annual accounts, the election of board directors and a plenary session for members. Full details will follow in due course.

New UKSCA Accredited members

We would like to congratulate the following members who have become UKSCA Accredited Strength and Conditioning Coaches (ASCC) since publication of the last journal:

Chris Baird, Darren Beattie, Chris Cahill, Eliot Challifour, Colin Clancy, Matthew Craythorne, Robbie Cuthbert, Anna Greco, Peter Habershon, Stuart Heaviside, Alex Horgan, Jacek Kondracki, Yianni Kyriacou, Benjamin Leach, Sinead McGann, Shaun McLaren, Steph Morris, Peter Mundy, Joe Murphy, Nathan Norris, Matthew Parker, Scott Pearson, Mitchell Pemberton, Jack Powley, Dale Read, William Rees, Ben Reid, Christopher Robinson, Sumeet Sondagar, Josh Taylor, Samuel Vance, Tulshi Varsani.

The UKSCA currently has just over 2500 members, 740 of which are Accredited members.

Strongman training – a rationale for its inclusion in S&C: Part 2

By **Arran McManus, Jamie M O'Driscoll, Damian Coleman,** and **Jim Wiles,**
School of Human and Life Sciences, Section of Sport and Exercise Sciences, Canterbury Christ Church University

OVERVIEW

This article – the second of a two-part series – aims to evaluate the integration of strongman-based exercises within the practice of strength and conditioning. It should give the reader a clear understanding of the specific physiological and biomechanical traits of each of the exercises discussed in Part 1. This information will then be used to discuss their amalgamation within traditional-based exercises within the planning of a periodised programme for strength and conditioning practitioners.

Introduction

Through its evolution, strongman-based exercise now refers to any form of unorthodox style lifting that utilises a multi-joint approach. Often it is associated with the lifting and pulling of unusually shaped objects, with examples of common exercises being the pulling and pushing of heavy motor vehicles, log pressing, farmer's walk, Yoke walk, Atlas stones, keg toss and tyre flips.[2,17] Not surprisingly, typical strongman exercises are characterised by high neural outputs and maximal total-body effort.[19] These exercises are characterised by the triple extension (hip, knee, ankle) movement pattern and have been shown to be effective in improving grip strength, trunk stability, gait loading pattern and whole-body conditioning.[10]

Due to the nature of these exercises, blood lactate levels have been measured as high as 16mmol·L^{-1}, compared to 7mmol·L^{-1} when partaking in traditional resistance training.[21,25,35] This suggests that the physiological (mainly anaerobic) demands of strongman exercises may exceed those in both free weights and machine-based resistance training. This high level of physiological stress is largely due to the high level of intensity and maximal load, combined with the unpredictable proprioceptive activation under which the body is placed.

In this context, the inclusion of strongman training exercises within the practice of strength and conditioning (S&C) is increasingly being viewed as advantageous, due to their effectiveness in stressing the whole body across multiple planes.[26] With that in mind, it can therefore be considered that strongman exercises could offer a more purposeful solution to training athletes to become both strong and robust: they can therefore be classified as highly functional for sporting performance.[1,22]

The diverse range of exercises – such as the 'keg toss' and the 'Atlas stone' – allows for training across the entire force-velocity

Figure 1.
The keg toss – an exercise which is increasingly used in sports such as wrestling, rugby, basketball and hockey

'The diverse range of exercises allows for training across the entire force-velocity spectrum'

spectrum and therefore would be suitable as a conditioning tool in a multitude of sports. This is supported by their increased acceptance in sports such as wrestling, rugby, basketball, hockey and American football.[2,17,20,35] Despite the growing body of evidence supporting effective strength gains with strongman training, its inclusion within a programme must still be rationalised to ensure training remains both purposeful and discipline-specific. It is therefore important that the S&C coach understands how the key principles of dynamic correspondence relate to the main strongman exercises, along with the physiological implications in order to help ensure scientifically sound training prescription.

The S&C coach should also seek to determine the intensity of the exercises relative to their degree of load, where in athletes who lack a sufficient degree of strength, substitute exercises could be adopted (suggestions are made later in the article). The relevant techniques and applications of the exercises, relative to guidelines for prescription, have already been detailed in Part 1; this article aims to evaluate the biomechanical and physiological demands relative to their inclusion within a periodised programme.

Biomechanics of strongman training

From a biomechanical perspective it could be suggested that some forms of strongman training – such as the 'farmers walk', 'yoke walk' and 'truck pull' – offer the ability to train athletes to produce high levels of unilateral ground reaction forces, in an attempt to produce powerful horizontal motion.[25] With the majority of traditional-based lower body resistance exercises requiring the application of bilateral vertical ground reaction forces (such as squats and deadlifts), it could be considered that the use of some strongman exercises – in particular the asymmetric carries and the truck pull exercise – would adhere more to the principle of specificity. This is particularly true for those sports characterised by high levels of horizontal motion where acceleration is a key movement pattern, as seen in hockey, football and netball[41] for example. These sports are also categorised by high levels of propulsive and braking forces,[7] due to the requirement for multi-directional movements.

It could be argued that more functional forms of traditional resistance training, such as multi-directional lunges or jumps, seek to train this type of force production.[23] Nevertheless, the unorthodox style of strongman training offers a greater degree of unpredictability within the movements, and as such could provide a solution for those coaches who question the suitability of well-rehearsed exercises, and their degree of transfer to performance, being largely characterised by stimulus-reactive movements.

It should be noted that the authors were only able to find two studies pertaining specifically to the biomechanical demands of strongman-based exercises. These studies were mainly focused on the kinetic and kinematic constituents of the tyre flip and the heavy sled pull exercise. The tyre flip has been sub-divided previously by Hedrick[20] into four phases, which include the first pull, second pull, transition and final push. This model was adapted in Part 1 of this article to the set position, upward movement phase, transition phase and the final push phase (see accompanying figures in Part 1).

A study by Keogh[25] aimed to define the temporal aspects of the tyre flip exercise, using a cross-sectional design where the three fastest and three slowest tyre flips were analysed. They further sub-divided the durations of each phase of the tyre flip in alignment with Hedrick's suggestions. The results indicated that the second pull had the greatest duration, followed by the first pull, with the transition phase taking the shortest time. This is widely to be expected due to the changes in primary agonists from first to second pull and the large amount of forces required to overcome the initial inertia. The results indicated that the second pull had the greatest duration, followed by the first pull, with the transition phase taking the shortest time. The long duration of the first pull is widely expected, due to the large amount of force required to overcome the initial inertia. It could be hypothesised that the second pull was of a longer duration due to the resultant muscular torque being substantially less than that of the first pull as a result of the change in primary agonists.

Kinematic analysis of the heavy sled pull, which provides resistance in a similar manner to the truck pull has been previously reported in six resistance-trained subjects.[25] Results identified kinematic similarities to the acceleration phase of sprinting; however, significant differences in stride length, stride rate, ground contact times and a higher degree of forward lean during the heavy sled pull were noted. Both stride length and stride rates were observed to be shorter, with longer ground contact times in an attempt to provide greater propulsive force. This appears synonymous with the relative load lifted: it could therefore be suggested that with even heavier loads – such as that of the truck pull exercise – changes such as these would be exacerbated further.

Research has challenged the use of loads greater than 20% of body mass for resisted sprinting type exercises due to the acute changes in sprint technique observed.[32] However, it is also argued that these are only acute changes, with contemporary science indicating overload of the muscles will lead to supercompensation and chronic adaptations.[25] This has been demonstrated in a recent pilot study by Morin et al,[31] who analysed 16 amateur soccer players carrying out two weekly sprint sessions (5 x 20m) for a period of eight weeks. The 16 participants were split into an intervention (n=10) and a control (n=6) group, in which the intervention group carried out each sprint with a sled tow equivalent of 80% body mass. The authors found significant increases in maximal force production and mechanical effectiveness (defined as more horizontally applied force) than that of a control group. This suggests the use of loads greater than 20% body mass could provide positive adaptations in particular to those sports requiring large amounts of horizontal force application.

This finding is further supported by Cronin,[11] who suggests that an increase of 23% in lower-limb strength can improve sprinting speed by up to 2%. Based on Cronin's[11] and Morin's[31] research, it could be suggested that the use of the truck pull exercise could be used to bring about lower-limb strength improvements and enhance speed properties (ie, greater impulse), to bring about improvements in sprinting speed.

There is a limited amount of research on the biomechanics of strongman training; more research in this area is needed. Both Hedrick[20] and Keogh[25] describe the tyre flip exercise with a second pull, with Keogh noticing that in the slowest tyre flips the duration of second pull was the key determining factor. The outline of the tyre flip described in Part 1, presents both the first pull and the second pull as one upward movement phase: this allows the athlete to transition to the push phase earlier

'use of the truck pull exercise could be used to bring about lower limb strength improvements and enhance speed'

Figure 2. Tyre flip

within the movement and also allows the continuation of momentum throughout the movement. In order to challenge both the upward movement and push phase further, the use of resistance bands may be used to apply greater resistant force on the athlete. In addition, supplementary exercises such as the 'jammer' and 'prowler' appear to offer comparable kinematic positions and may aid in the application of vigorous horizontal force application in this way, and subsequently improve tyre flip performance indirectly.

It has also been suggested that the inclusion of strongman training within a periodised programme may also lead to greater overall trunk stability in athletes.[20,35] This increase in trunk stability could be due to the requirement of large amounts of muscular activation during the torso-bracing pattern, a pre-requisite to safe and effective lifting of extremely heavy loads.[30] This is further evidenced in the 'asymmetric carry exercises', such as the farmer's walk, something which entail a variety of unbalanced and awkward loading, which is not trained during bilateral conventional lifting. The ability to adapt and include this form of exercise with both variable and static loading challenges body linkages and requires strong stabilisation to overcome an uneven distribution of load.[30] However, there is limited information so far on both the kinetics and kinematics of strongman exercises, and in order to obtain a more detailed understanding, further research is warranted.

Physiology of strongman training

Due to the requirement of maximal strength exertion, it is apparent that a number of distinct physiological responses occur that create a unique internal environment conducive to physiological supercompensation and – ultimately – improvements in maximal strength, power and strength endurance. The level of intensity of strongman exercises means that high neural outputs are required, placing significant demands upon the central nervous system.[19] Adaptations such as increased neural excitation, firing frequency and rate coding all occur where high neural demands are present.

'the level of intensity of strongman exercises means that high neural outputs are required'

Berning et al[3] set out to quantify the metabolic demands of the truck pull exercise. The authors recruited six experienced (>5 years) strength-trained athletes with 1RM back squat totals at 3 x body mass: they were required to pull a motor vehicle weighing 1,960kg a total distance of 400m. It must be noted that even for a professional strongman competitor this is an extreme distance, with competition distances set at 30m. Oxygen consumption and heart rate were measured continuously, with blood lactate measured immediately prior to, and five minutes' post, truck pull.

The athletes found the exercise to be extremely exhausting, with near maximal heart rate sustained over several minutes and blood lactate values averaging 16.1mmol·L^{-1}, with the highest value being recorded at 18.4mmol·L^{-1}. This high level of blood lactate concentration has been shown to bring about the onset of metabolic acidosis, which could promote adaptations in both lactate tolerance and clearance.[34] With a greater tolerance to lactate and a faster clearance rate, the body's ability to delay the build-up, this may allow athletes to sustain high amounts of strength exertion over a greater duration, giving adaptations for improved strength endurance.

However, it must be acknowledged that the truck pull exercise in its acute form could bring about negative implications for training adaptations due to the exhaustive demands placed upon the body. This is of particular importance for those athletes who require large amounts of technical or tactical training. In addition, this form of training will require substantial recovery periods in order for the body to fully recuperate; time-constraints are also a potential issue. It is therefore suggested that the positioning of this exercise within a periodised programme fits in the general preparatory phase (GPP), where the focus is on obtaining a sound strength base, and reduced levels of technical training are likely to be prescribed. The inclusion of this type of exercise requires careful planning, with the S&C coach needing to manipulate its timing, frequency, and intensity, mostly on an individualised basis. This process should negate the potential possibility for overreaching or overtraining syndrome, which can often occur due to the psychological arousal brought on by this form of exercise.

The high lactate production produced in this exercise appears apparent across the majority of strongman exercises, with Keogh[26] observing significant increases in blood lactate values from resting values of 2.4mmol·L^{-1} compared to 10.4mmol·L^{-1} after the tyre flip exercise. Final lactate values were measured 2.5 minutes after completing two sets of six repetitions and could largely be explained by the large muscle groups recruited, placing excessive physiological demands on the body.[29] These high lactate values will undoubtedly bring about increases in testosterone concentration, as is observed during other short term high intensity anaerobic exercises.[27]

These findings are also supported by Ghigiarelli et al,[16] who analysed salivary testosterone levels in 15 subjects during three resistance training protocols, one of which was solely strongman training and included the tyre flip, farmer's walk, keg carry, and Atlas stone lift. The other two protocols consists of a mixed hypertrophy and strongman training protocol, and a hypertrophy-only training program. For the hypertrophy training protocol, exercises were carried out based on 75% of individual repetition maximum, calculated through repetitions to failure for the squat, bench press, leg press and seated row. The strongman protocol was not, however, prescribed based on 1RM, but instead the subjects were required to perform three sets until failure. However, due to the unfamiliarity of the strongman exercises, failure did not always occur during the first set and as a consequence, additional load was added for the remaining sets.

The authors sampled testosterone levels at rest, immediately post and 30 minutes' post training for all protocols. All conditions resulted in a significant increase from baseline testosterone levels, with strongman training increasing baseline levels by 74%, mixed hypertrophy and strongman training by 54% and hypertrophy training in isolation by 137%. Although this evidence suggests that hypertrophy training in isolation brings about greater increases in testosterone concentrations, this study has an important limitation relative to the strongman protocol. The unfamiliarity caused inconsistent prescriptions in intensity, and therefore exercising to failure did not always occur during the initial set.

Although it may be argued that hypertrophy training augments greater adaptations in muscle protein synthesis, the use of strongman training may still provide a useful training stimulus if the desired outcome is maximal strength with the additional advantage of heightened trunk activation, due to the un-even lifting nature of certain exercises.[30]

Increases in testosterone have also been shown to bring about additional positive physiological adaptations such as an increased anabolic state and skeletal muscle alterations (hypertrophy).[4] This is likely to have positive implications for sporting performance, and recovery time during sports characterised by repeated anaerobic bouts of energy expenditure, due to the body's enhanced adaptation during an anabolic state. Strongman exercises could therefore be prescribed to bring about such positive adaptations indirectly.[16] This is supported by Winwood et al,[40] who reported chronic morphological adaptations to be similar to that of traditional resistance exercises. In a study of 30 experienced

'high lactate values will undoubtedly bring about increases in testosterone concentration'

Figure 2.
Athletes find the truck pull exercise extremely exhausting

rugby players who were randomly assigned to either strongman or traditional based resistance exercises, participants carried out two weekly sessions for a period of seven weeks where exercises were matched through biomechanical similarity and equivalent loading.

The authors reported strongman training to have similar effects to traditional based training in improving body composition and functional performance measures (0.2-7%). These results have been adapted for clarity and are presented in Table 1.0. Although these comparable effects have been observed, the methodology around testing procedures could be questioned, with exercises such as the 'bent over row' offering little scope for standardisation. In addition, it was also noted that the seven-week training programme was not monitored by the researchers; thus, results should be interpreted with caution. That being said, the results of this study may still argue that the large time under tension which is created during the majority of strongman exercises could lead to greater improvements in both isometric and eccentric strength.

Zemke et al[41] suggest that performing asymmetric carrying events would generate a large amount of tension in both the trapezius and upper back musculature, as the strongman attempts to stabilise the load for a prolonged duration. Although this suggestion has some degree of premise, in order to substantiate this claim, further research is warranted.

These physiological adaptations give support to the use of strongman exercises during the GPP of a periodised programme in an attempt to bring about adaptations in muscular strength and hypertrophy. The necessity to prescribe strongman exercises during this phase to induce a series of morphological adaptations is further strengthened by adherence to the principle of variation. The exercises offer alternative kinematic and stability demands, all of which have been shown to reduce stagnation and training plateau.[40]

Epidemiology / injury risk

The contention surrounding strongman exercises is largely based upon concerns about their safety and the perception that they may increase the likelihood of injury to the athlete during training.[2] This assumption is mainly based around the intensity of the exercises, and their unorthodox style which can produce some high physiological stresses on the body. However, it has been proposed as a counter-argument that these stresses may themselves actually play a role in injury prevention rather than causing them, as the athlete's body will have more strength in uncontrolled situations, which is a particularly desired quality in contact sports.[41]

Winwood et al[39] sought to interpret the injury incidence of those participating in strongman exercises. They reported approximately 5.5 injuries occurred per

Table 1. Magnitude of changes to functional performance measures after a seven-week strongman or traditional resistance training intervention (adapted from Winwood et al[40])

FUNCTIONAL PERFORMANCE MEASURES	STRONGMAN	TRADITIONAL	EFFECT SIZE
Vertical jump height (cm)	+4.13 ± 6.356	+3.86 ± 5.37	0.09
Horizontal jump (m)	+0.03 ± 0.115	+0.09 ± 0.11	0.56
5-0-5 Change of direction test (s)	-0.01 ± 0.13	-0.04 ± 0.07	-0.25
Change of direction acceleration (s)	-0.01 ± 0.06	+0.02 ± 0.04	-0.33
30m sprint speed (s)	-0.02 ± 0.10	-0.01 ± 0.06	-0.18
5m sprint speed (s)	-0.02 ± 0.04	-0.01 ± 0.03	-0.28
Muscle mass	+0.4 ± 0.8	+0.0 ± 1.0	0.44
Seated 5kg medball chest throws (m)	+0.16 ± 0.19	+0.15 ± 0.19	0.05
70kg sled pushes, 5m, 10m and 15m (s)	-0.2 to -0.5 ± 0.11 to 0.20	-0.09 to -0.14 ± 0.10 to 0.16	-0.31 to -0.46
1RM bent over row	+14.5 ± 9.0	+4.7 ± 8.8	1.10
1RM squat	+3.9 ± 16.1	+10.9 ± 13.7	0.47
1RM deadlift	+10.4 ± 10.9	+17.8 ± 11.8	0.47
Body fat mass/body fat percentage	-0.3 ± 2.0	-0.4 ± 1.6	-0.38

every 1000 hours of strongman training: this equates to 1.5 more injuries occurring every 1000 hours compared to both powerlifting and weightlifting.[8] Although these figures may lend support to the argument that strongman training increases the risk of injury, it should be noted that these studies are retrospective in design, where participants exposed to strongman exercises are required to complete a 'self-reported injury recall evaluation' for a period of one year. This kind of study has the potential for error when recounting both the severity and site of injury, with the interpretation of minor and major injuries affecting the validity of these results.[15,36]

Winwood's results[39] offer support to this argument in that 16% of the injuries sustained were recorded as 'unsure' relative to their nature. Furthermore, without any details pertaining to the level of coaching or techniques adopted during this study, it is difficult to fully attribute any 'recollected injuries' to one specific factor alone.

It is widely accepted that one of the major preventers of injury in any form of exercise is the utilisation of effective technique, to ensure postural control and equal distribution of loading.[9,28] As with any form of exercise, it could be argued that with sufficient coaching and monitoring of correct technique, the incidence of injuries within strongman exercises may be reduced. It must be further noted that, due to the high degree of instability some of the strongman implements possess, additional care should be taken within the early stages of coaching technique. This precaution is further supported through the results of Winwood's study indicating those lifters who had more than four years of strongman lifting experience endured less injuries in comparison to those less experienced.

The most common sites of injury for the strongman competitor are reported to be the lower back, shoulder, knee, and biceps,[5,30,33] with the farmer's walk, tyre flip, clean and press, Atlas stones and Yoke walk accounting for 77% of all injuries sustained.[38] McGill[30] sought to quantify spinal loading and muscular activity during a series of strongman exercises and reported that compressive spinal loading was highest during the Yoke walk, which was contrary to their prediction of the Atlas stone. These results could be explained due to the initial loading in the Yoke walk exercise adopting a bilateral stance, with the initiation of movement adopting a unilateral stance. During this initiation, the athlete would be required to produce strong hip coordination during the 'leg swing phase', which would require a greater bracing action of the torso musculature, in an attempt to support the extreme load. This gives a clear indication that the loading of this exercise needs to be carefully considered from a unilateral standpoint and not the initial bilateral phase. From this point, coaching should focus on pelvic alignment to minimise the stress on the lumbar spine in particular, remembering that this is a common site of injury occurrence.

Maintaining joint alignment and the up-regulation of target muscles is synonymous throughout any form of exercise prescription, with particular focus on those exercises that require large ranges of motion such as the hip and shoulder. This is evidenced further with overhead exercises (log press), where adopting a hand and elbow position anterior to the shoulder may reduce the degree of shoulder injuries observed.[11,12] This is synonymous with traditional-based resistance exercises where poor technique can produce excessive hip extensor torques and high shear lumbar forces.[5,13,14] It is therefore important that the coaches focus on cueing a neutral lordotic curve (aided by bracing through the anterior trunk), correct shoulder alignment, and equal weight distribution during the lifts.

Although strongman training has indicated higher incidences of injury, it appears effective coaching relative to technique and postural awareness should increase the safety of these exercises. As with any form of exercise programme, there will undoubtedly be some degree of risk involved; however, by utilising a structured exercise programme, with correct coaching and appropriate regressions and progressions where necessary, both the incidence and severity of injuries can be markedly reduced.

Practical application/programming

The current research evidence surrounding strongman training highlights its importance in bringing about positive physical adaptations, which may enhance sporting performance.[19] This is largely due to its association with a term coined 'imperfection training', which provides a stimulus for training strength in unexpected and suboptimal conditions, that may be encountered within sport.[37] As such, it is recommended that, where possible, strongman exercises should be amalgamated with traditional resistance-based

'One of the major preventers of injury is the utilisation of effective technique, to ensure postural control and equal distribution of loading'

Table 2. An example of a training programme incorporating strongman exercises for a rugby player, training lower body strength, during the GPP of a periodised programme

EXERCISE	SETS	REPETITIONS/DISTANCE	TOTAL LOAD	REST INTERVALS
Log clean and press	4	6	85%	3-4 minutes
Strongman back squat	4	6	85%	3-4 minutes
Single leg RDLs	4	6	85%	3-4 minutes
Back extensions	5	5	85%	3-4 minutes
Yolk walk	3	20 metres	85%	3-4 minutes
Prone holds	3	30 seconds	85%	30sec-1 minute

Table 3. An example of a training programme incorporating strongman exercises for a wrestler, training whole-body strength, during the GPP of a periodised programme

EXERCISE	SETS	REPETITIONS/DISTANCE	TOTAL LOAD	REST INTERVALS
Atlas stone	4	5	85%	3-4 minutes
Tyre flip	3	6	85%	3-4 minutes
TRx rows	4	5	85%	3-4 minutes
Weighted chin-ups	3	6	85%	3-4 minutes
Farmers walk	3	20 metres	85%	3-4 minutes
Barbell roll-outs	3	8	Bodyweight	2 minutes

methods to bring about greater functional strength and stability, during the GPP of a periodised programme (see Tables 2.0 and 3.0). This phase is largely characterised by high volumes of training at varying intensities, ideally adopting whole body exercises, such as the log clean and press. Its adoption within this phase will aid to build a solid physiological foundation of strength, speed, balance, flexibility and an increased working capacity.[35] This amalgamation will also aid the principle of variation which could potentially overcome plateaus and prevent stagnation due to an increase in motivation and training adherence.[40]

Some coaches within the industry still seem to avoid the use of strongman exercises because of a perception that they lack specific movement patterns within sports.[2] However, a closer analysis of the movement patterns within these exercises identifies strength and power in triple extension and therefore makes their use highly relevant to sport. This is supported by evidence that suggests they have benefits in sports such as rugby, hockey, football, basketball and wrestling.[1,20]

The positioning of strongman training within programme design relative to recovery periods, intensity and volume is largely based on anecdotal evidence, due to the apparent lack of research available. As with any form of exercise regime, insufficient recovery periods could potentially bring about exhaustive effects, which could be detrimental to an athlete's immediate performance.[18] The majority of strongman exercises are measured through loads lifted, distances carried, or a combination of both. The manipulation of these variables can be centred around gains in strength, through increase in load, or strength endurance through an increase in distance covered with the variations in rest periods bringing about adaptations in anaerobic working capacity. In load-based strongman exercises, it is recommended that repetitions between four and eight are adopted.[36] This is to ensure steady progression; as such, if eight repetitions are comfortably achieved, then the load can be increased with a target repetition of 4-6. Strongman exercises over distance are often carried out over 30 metres: this can be increased if strength endurance is the training goal for the session. The sets can be manipulated for the majority of events to cover desired training volumes, with the exception of the truck pull.

Due to the physiological demands and high lactate levels produced in this exercise, this should be carried out as one movement and should not be carried out for a period greater than 60 seconds.

Attention to the duration of strongman exercises is a key variable that should be appropriately planned in an attempt to reduce excessive overload on muscle tissue. With human tissue carrying a degree of tolerance to the magnitude of load enforced, a prolonged increase in mechanical loading on the musculoskeletal system could predispose the body to injury.[24]

The amalgamation of strongman exercises has also been suggested to be successful during the late 'specialisation phase' of a periodised programme, where training becomes more specific.[41] This is based on the premise of exercises such as the keg toss and Atlas stone training explosive strength in the triple extension movement pattern. Further to this, exercises such as the farmer's walk challenge torso stability, grip strength and strength endurance: key components in sports such as wrestling and American football.[1,20] These exercises could be further adapted through walking in lateral motions, or adopting the Zercher position.

Although there are many uses and adaptations of the exercises that can be adopted, it is important that the S&C coach takes into consideration the wider aspect of their athlete's needs, when incorporating these exercises during training phases closer to competition periods. Furthermore, if athletes are engaging in maximal effort tasks such as sprinting or plyometrics, it is suggested that strongman exercise prescription should be avoided prior to these sessions, so as to minimise neural fatigue.

The monitoring of fatigue is also an additional aspect that the S&C coach should be aware of with this form of training. Although it is recommended that the most accurate measures are used when including strongman exercises (such as blood lactate values), this can often be problematic when access to these measurement tools are limited. In order to combat this potential issue, coaches should seek to adopt various methods where appropriate. Using the session 'rate of perceived exertion' (sRPE) method could provide a useful comparison when compared with traditional weight-room sessions in particular. Coaches who have access to data in previous seasons may choose to use this to compare current season loads. Although these methods are largely indirect, they can form a reliable field-based method for monitoring the key variables which may have implications on levels of fatigue; they are also good indicators of when to manipulate training volume.

Conclusion

The evolution of strongman training is largely characterised by its increased popularity and media attention. It was initially adopted within the practice of S&C due to its competitive nature and opportunity for variety within exercise programmes. Evidence suggests that strongman exercises should be used to complement traditional resistance exercises during the planning of a periodised programme.[2] With increased awareness of technique and familiarity of exercises, coaches will become more skilled in manipulating combinations and also programme variables so as to continually challenge athletes towards their desired training goals.

Although the safety of this genre of exercise is still widely debated, largely due to the lack of data on the subject from studies, it is undoubtably true that this type of exercise challenges the entire musculoskeletal system. Future research should be directed towards quantifying the amalgamation of strongman exercises and traditional resistance training to promote optimal training prescriptions: this would offer coaches more robust guidelines into the adoption of these exercises.

AUTHORS' BIOGRAPHIES

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RAMP warm-ups: more than simply short-term preparation

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INTRODUCTION

One of the greatest challenges facing any coach is time. It is rare to hear of a coach who has sufficient time to dedicate to all the potential areas for performance enhancement. Indeed, even if a coach had all the time he or she required, the amounts of work that they can do will be limited by the athletes' training capacity. Training prescription is therefore always a matter of choice, and coaches are making daily decisions as to how best to allocate the time and athletes' energy available to them. It can be argued that we can do anything, but we can't do everything and that decisions as to training priorities are essential to the work of a strength and conditioning coach.

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Towards efficiency and effectiveness

The prioritisation of training naturally requires us to carefully consider two key concepts: that of efficiency and effectiveness. Efficiency can be thought of as the ability to accomplish something with the least waste of time and effort. With efficient training, athletes are able to best achieve their performance goals, within the restrictions of the time and energy available.

Efficiency is an important concept, but it must always be considered in the light of effectiveness. Although training efficiency can be an important goal, if it comes at the cost of effectiveness then it is not truly efficient, as the key objective of any training input will not have been accomplished, and other inputs will then be required to achieve the goal. The converse of course is that training can be effective, without necessarily being efficient, and full evaluation of these training inputs needs to consider the amount of time and energy dedicated to achieving a given goal, and its net effect on the rest of the athlete's training programme.

Athletic development and team sports: the challenge

One of the great challenges of the majority of team sports is the range of fitness parameters that an athlete competing in the sport has to develop. Add to this the technical and tactical requirements of the game, together with an often-crowded competition schedule, and the challenge of effective athletic development becomes even more complicated. Therefore, training systems that are able to address multiple training goals, but at no increased cost in terms of time or energy, become especially valuable. It could be argued that one of the most powerful tools available to a strength and conditioning (S&C) coach, or indeed to a sports coach, is the warm-up. For a S&C coach, this is one of the few areas where they will typically have an important input, if not actually being totally in charge of the process. Consequently, the warm-up provides an important tool via which several training objectives can be accomplished. Although this area has seen significant change in the last 5 to 10 years, it is still

‘To maximise performance we need to ensure that the quality of work performed is always technically correct’

questionable whether its potential as a fundamental part of every training session is being fully exploited.

Taking a new look at warm-up

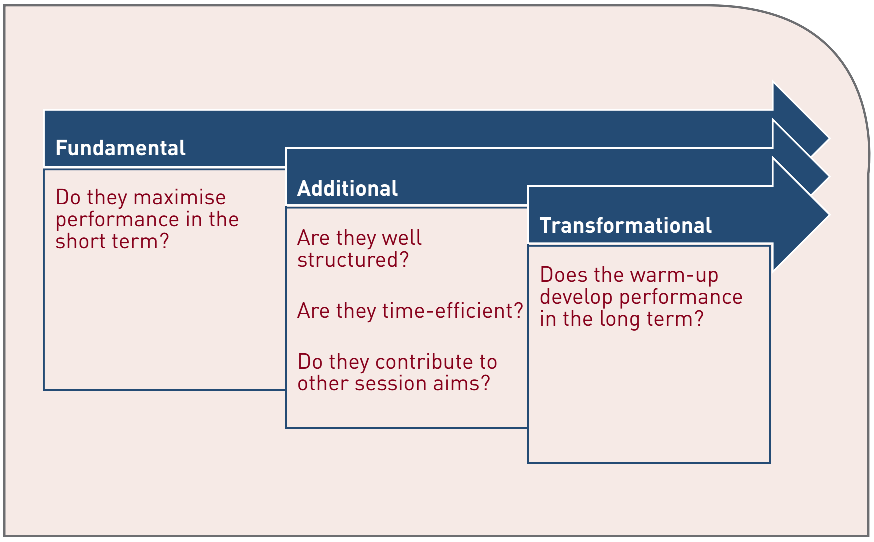
Although the physiological benefits of an effective warm-up are relatively well-established in terms of both temperature-related and non-temperature-related aspects,[1,2,3,5,7,11] the use of a warm-up as a key ‘training’ tool rather than as a purely ‘preparational’ tool is less well developed. To maximise the potential benefit of warm-up in terms of the overall athletic development of an athlete requires a shift in emphasis and an awareness of the multiple benefits that effective warm-ups can bring to athletic development over the longer term. Figure 1 outlines key considerations which should form the backbone of the planning of an effective warm-up. This shows how effective planning clearly needs to consider the short-term effects of the warm-up, but also how wider considerations can significantly enhance the overall benefits the warm-up can bring in terms of efficiency – and also in terms of benefits relating to longer term athletic development.

Do warm-ups maximise performance in the short term? This is the traditional view of the warm-up as preparation for performance. Here, activities need to be chosen which maximise performance in the upcoming session or competition. Indeed, most research on warm-up looks at the effectiveness of specific interventions on subsequent levels of performance, and recommendations are made based on these changes of performance. Undoubtedly this provides excellent insight into the types of activities that can be included in warm-up, but this isolated approach needs to be balanced against wider considerations, considerations that can significantly impact upon the overall efficiency and effectiveness of the wider training programme.

Expanding the thought process is essential if decisions are to be made that balance short-term effects with wider considerations and importantly with longer term athletic development. For example, an intervention may be able to elicit a slightly enhanced performance in a subsequent activity, but the logistical challenges of implementing the approach may mean that the overall warm-up becomes time inefficient, and other activities that provide longer-term benefits are omitted. Other important questions, therefore, need to be addressed in addition to the traditional thought process.

Are the warm-ups well structured? Although the impact of specific interventions has been well documented, what is less well established is the optimal structure of a warm-up, and how effective sequencing can ensure that benefits from one activity can facilitate performance in a subsequent activity. For example, mobility has been shown to be improved by an increase in muscle temperature, and so mobility-based activities may be best preceded by activities that raise body temperature. Similarly, the Treppe effect outlines how muscle contraction force is enhanced by prior muscle activity, with stronger muscle contraction rates (even in response to stimuli of the same strength) with each successive contraction.[12] Effective warm-ups should involve an initially low intensity of exercise and a graded increase in activity intensity up to high intensity effort. Thoughts can then focus upon how best to elicit these effects in combination with other key questions.

Figure 1. Considerations in warm-up design



Are the warm-ups time-efficient? Although the warm-up is a key part of an overall session, typically the main aim of any given session comes in the main body of the session. In this way, warm-ups should be planned to achieve their key goals in as time and energy-efficient a way as possible. This requires a careful consideration of every activity included in the warm-up and evaluation of whether it contributes to performance, either in the short term, the medium term or long term. This should involve a careful analysis of the efficiency to effectiveness ratio, and its impact upon the subsequent session.

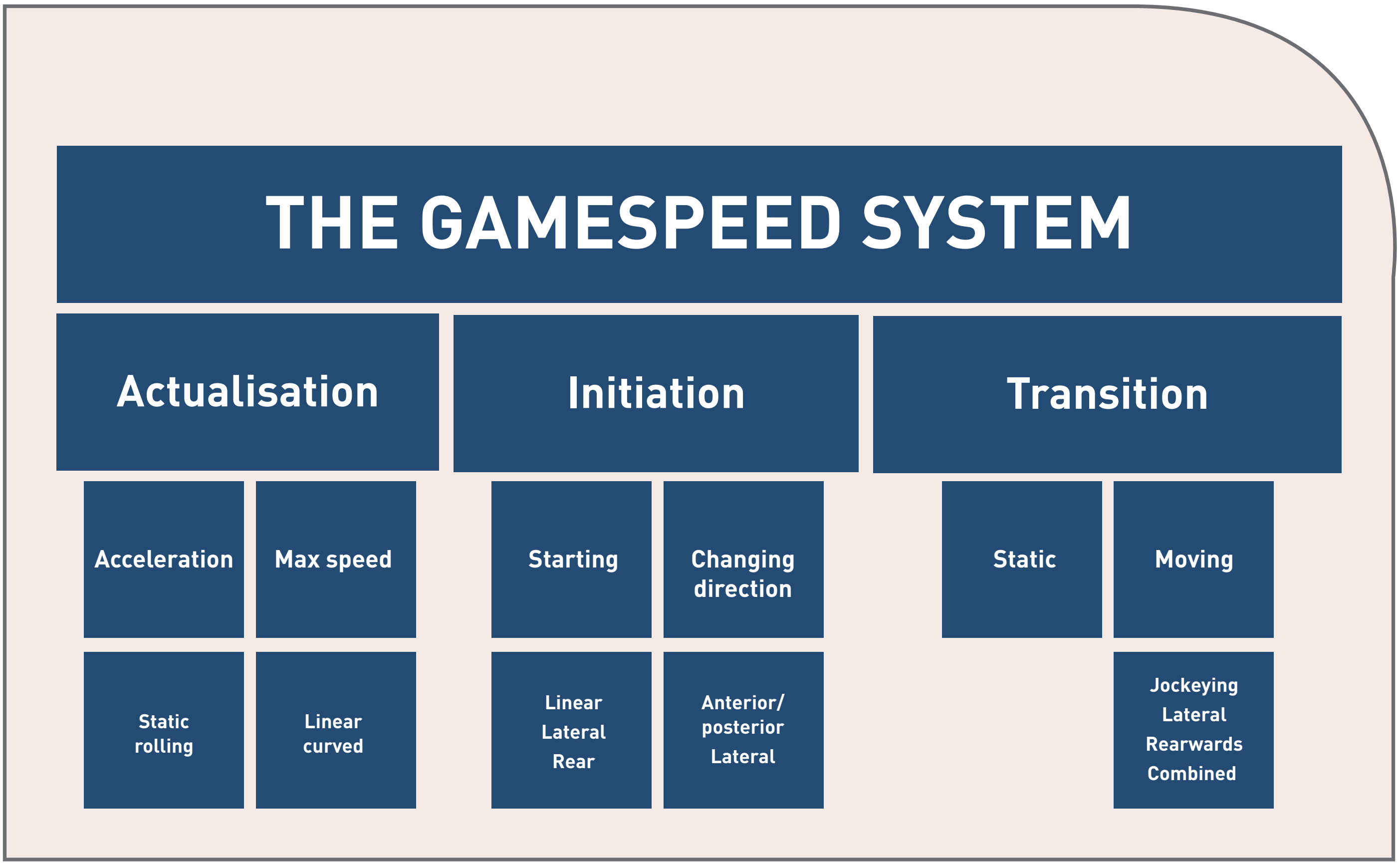
Do they contribute to other session aims? Typically, a well-planned session will have a number of objectives. Effectively planned warm-ups need to look beyond purely physiological preparation, and need to incorporate considerations of skill development, and other key goals of the athlete's programme. In this way, warm-ups can be planned that contribute directly to the activities and the goals of the main session.[9] This will then provide a seamless transition between the warm-up and the main session. However, although an important consideration, at times this can become a straightjacket and coaches need to be comfortable in both integration and separation of the warm-up from the main session, with the separation aspects being intricately linked to the long-term planning considerations.

Does the warm-up develop performance in the long term? This question is a major departure from the traditional warm-up thought process. Typically, warm-up planning is built around the first consideration, but incorporating the other three considerations into this planning results in a more efficient and overall effective warm-up. However, incorporating a fifth consideration dramatically changes the planning process of warm-ups and is transformational in terms of big picture thinking. Consideration of whether the warm-up maximises performance in the long-term takes planning to a different level, as rather than simply thinking about warm-up as a short-term tool for preparation for an upcoming session, it opens up the warm-up as a key tool in overall athletic development. Armed with this form of thinking, activities can be chosen, not simply around the impact on the subsequent session, but importantly on their impact on the athletes' overall athletic development.

So, although two activities could conceivably have the same short-term impact, the use of activity that incorporates movements or skills that can provide gains in the longer term becomes a preferred option. It is here that the concept of separation mentioned earlier is essential, as it allows the development of a capacity that may not be covered in the main session, but which is essential to the athletic development of the athlete, and the warm-up may be the only opportunity to develop this capacity. In this way, the ability to separate the warm-up from the upcoming session becomes a key skill, in addition to the ability to integrate where needed, and the ideal scenario will depend upon the nature of the warm-up, the upcoming session and the overall athletic development picture. Critically, this requires a long-term approach to warm-up planning, and how everything fits into the athletic development jigsaw.

'Does the warm-up develop performance in the long term?'

Figure 2. The Gamespeed Target Movement Syllabus



One of the great benefits of thinking longer term in relation to a warm-up is the direct effect it has on skill development. According to Ericsson,[6] the key determinant of skill development is the quantity of deliberate practice. By including deliberate practice, on key fundamental movement patterns, key locomotor patterns, and key sport skill patterns in each and every warm-up, this provides for an extensive application of deliberate practice, but at no added cost in terms of either time or athlete energy expenditure.[9] In this way, targeted activities during warm-ups allows these skills to develop in each and every session.[11] Although in the short term, this may not appear to make a huge difference, simply 10 minutes spent on skills for two sessions per week results in 80 minutes of skill development each and every month. Over the course of the year, and especially over the course of an athletic career, this amounts to a considerable amount of additional skill development.[11]

The proviso here is that this work is supported by effective coaching and the emphasis is placed on optimal application of this skill development. Unfortunately, all too often, not enough emphasis is placed on the performance of activities during the warm-up, and often athletes simply go through the motions of the activities and fail to take advantage of the skill development opportunities that accrue. To maximise performance we need to ensure that the quality of work performed is always technically correct, and that we are as assiduous in our coaching during warm-up as we are in the main body of the session. Critically, this also requires that we develop an optimal performance model for all of the movements that we perform in our warm-up.[9]

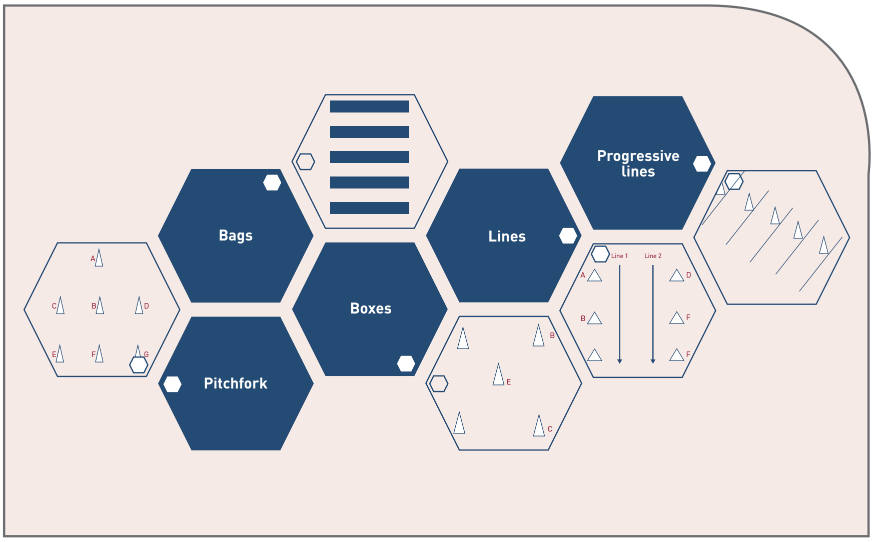


Figure 3. Sample 'Raise' phase movement set-ups

The RAMP warm-up structure: maximising performance in the short and long term

The RAMP warm-up system[8] was designed to address all the previous considerations. Its structure maximises performance in the short term, but additionally it provides a sequence by which each activity optimises subsequent activity in a time and energy efficient manner. Similarly, its potentiation phase, whereby carefully selected activities provide a progressive increase in intensity towards a main session, help ensure that the warm-up can assist with the achievement of the main session goals.[8,9] However, perhaps the main advantage of the effective use of the RAMP system lies in its potential to maximise athletic performance in the long term. By carefully selecting activities that are used in each phase of the RAMP warm-up, with due consideration as to the longer-term impact of the activities, as well as the short-term impact, allows the selection of activities that not only contribute to performance in the current session, but critically to the overall athletic development of the athlete. In this way, the RAMP system is built around specifically targeted activities aimed at enhancing performance in the short, medium and long-term.

RAISE

Athletic performance is enhanced by the achievement of optimal muscle and body temperature.[1,2,7] The main short-term aim of the raise section of the warm-up is to raise body temperature and other physiological parameters through the use of carefully targeted activities. Although this phase will have key physiological aims, such as increasing muscle elasticity, increasing muscle contraction rates, increasing oxygen delivery and uptake, diverting blood flow, raising body temperature, etc,[8] what separates it from a traditional general warm-up is that the activities themselves are carefully selected and highly specific to an athlete's goals. In this way, it differs hugely from a general warm-up in which the key aim is to raise physiological parameters and hence the activity chosen is largely arbitrary and the main consideration physiological rather than developmental. In the Raise phase, there still remains a physiological consideration, but the decision-making is based around how to achieve that, while at the same time also optimising long-term skill development. Typically, Raise activities revolve around the development of locomotor movements, the development of skills, or a combination of both.

In terms of locomotor movement development, the target classifications of the Gamespeed system[9] provide a virtual movement syllabus that can be used to ensure that all key locomotor patterns utilised in sport are addressed (see Figure 2). Typically, a range of activity set-ups can be utilised, which allow a high-density of movement activity to be achieved in a relatively small area. This set-up allows several athletes to be warmed up at the same time, but critically allows a coach the opportunity to observe as many of these activities as possible. This is especially important in the early stages of skill development where the optimal application of each movement is critical. Figure 3 outlines some commonly used set-ups within the Gamespeed system, with each allowing for a wide range of movements and movement combinations to be achieved.[9] The set-ups also allow for development of the movement patterns, from discrete through to simple combinations, through to multiple combinations, through to decision-making activities. In this way, progression can be achieved both within each session and importantly over time. Effective combination of the set-ups over a given time period allows for variety, but also can ensure that each movement pattern in the syllabus is covered each week, allowing for considerable practice on these fundamental patterns over time.

The use of skills to achieve the key aims of the raise phase is another important application. Here, movements are combined with the applications of skills, to achieve a high density of skill applications in the given time. The type of Raise activity will typically vary depending upon the context. If the activity is for a given sport, then it is likely that the Raise phase will consist of skills associated with that sport, whereas if it is a multisport set-up then skill application can revolve around a range of basic sports skills such as catching, throwing, kicking, hitting, swinging and jumping. Again, as for the movement patterns, it is important that these activities are performed with excellent technique, and thus it is important that the conditioning coach is armed with the ability to determine effective performance in all of the skills utilised within the warm-up, as well as knowledge about the movement patterns themselves.

ACTIVATE AND MOBILISE

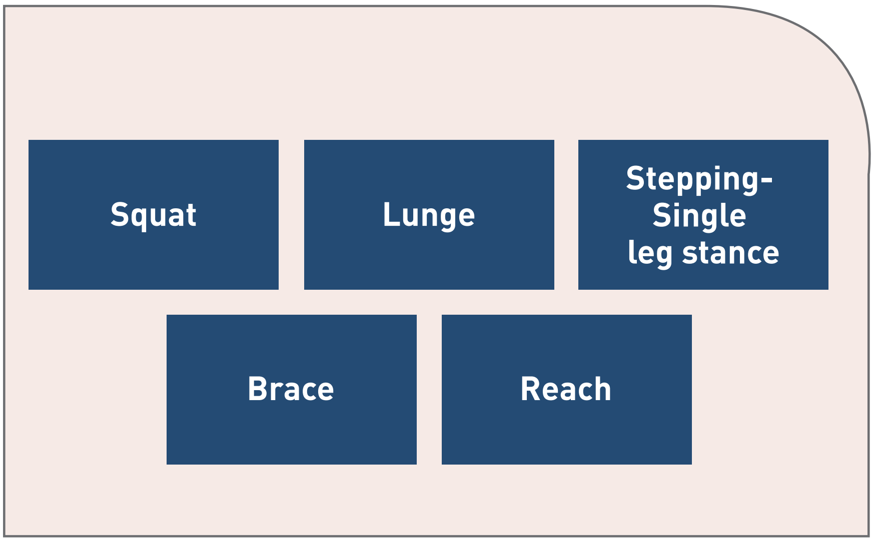
This phase follows on from the Raise phase, as the key physiological benefits achieved during the previous phase contribute to effective performance in the activate and mobilise phase. Although in the short term the aim is to move the body actively through an increased range of motion, in the long term this phase allows extensive practice of key fundamental movement patterns. This combination of long and short term thinking importantly stresses the advantage of dynamic activities over more static activities. The use of dynamic activities has several advantages: first, it maintains the temperature-related benefits of the raise phase; secondly, it moves the body actively through a progressively increasing range of motion; and thirdly, it avoids the potentially negative effects of static stretching on performance.[11]

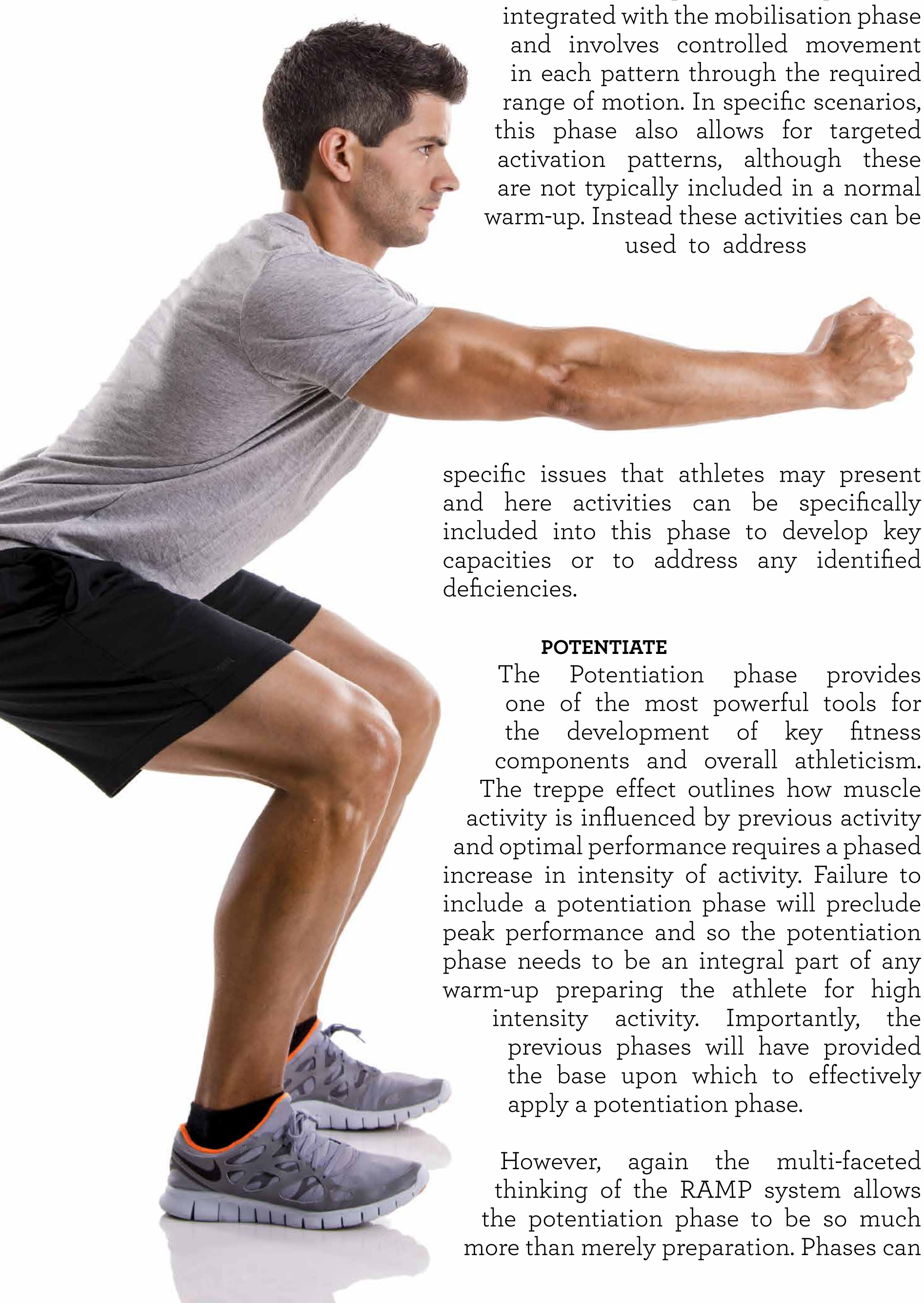
Ironically, when viewed from an efficiency and long term effectiveness point of view, the third of these is probably the least important consideration. Viewed from an efficiency point of view, the use of dynamic activities which involve movement around a range of joints, and which also address the key components of mobility – including the ability to control movement via the appropriate development of motor control, stability etc[4,11] – clearly have advantages.

Similarly, a long-term view allows the phase to be used for the development or maintenance of fundamental movement patterns. A highly popular system of movement assessment over the past few years has been the functional movement screen, which outlines a range of movements which are considered fundamental to effective performance.[4,11]

Although assessment is important, what is of equal importance – or indeed more – is the ability to address any movement issues through targeted actions. It is here again that the RAMP system is especially important, as

Figure 4. Fundamental mobilisation pattern groups





the activation and mobilisation phase allows the performance of the key fundamental movements required for effective performance in each and every session. Figure 4 shows some key fundamental movement patterns: a selection of an activity from each group allows the movement pattern to be practised, and also ensures that each key joint is mobilised appropriately. Additionally, each movement pattern can be part of a progressive sequence. In this way, challenge can be provided once a basic movement is established. So, for example, a lunge can progress through a static lunge, to a walking lunge, to a lunge with varied directional reaches to a lunge with varying degrees of rotation.

The activation aspect of the phase is integrated with the mobilisation phase and involves controlled movement in each pattern through the required range of motion. In specific scenarios, this phase also allows for targeted activation patterns, although these are not typically included in a normal warm-up. Instead these activities can be used to address specific issues that athletes may present and here activities can be specifically included into this phase to develop key capacities or to address any identified deficiencies.

POTENTIATE

The Potentiation phase provides one of the most powerful tools for the development of key fitness components and overall athleticism. The treppe effect outlines how muscle activity is influenced by previous activity and optimal performance requires a phased increase in intensity of activity. Failure to include a potentiation phase will preclude peak performance and so the potentiation phase needs to be an integral part of any warm-up preparing the athlete for high intensity activity. Importantly, the previous phases will have provided the base upon which to effectively apply a potentiation phase.

However, again the multi-faceted thinking of the RAMP system allows the potentiation phase to be so much more than merely preparation. Phases can be designed to address a range of capacities, including speed, agility, power, applied movement capacities and applied sport skills. Essentially, the potentiation phase is a progressive sequence of activities that maximise performance in the upcoming session, but also develop targeted skills and abilities that leads to optimal performance in the short, medium and long-term.[8,11] In essence, the potentiation phase can be a discrete session in itself aimed at developing a specific capacity or theme or phased towards a main session, including activities that will enhance performance both physiologically and skill based in the upcoming session.

Discrete sessions are where the potentiation phase focuses on a key capacity that isn't necessarily related to the upcoming session. So, for example, the potentiation phase can be targeted at the development of maximal speed, which – although important to sports performance – isn't necessarily the focus of the upcoming session. It is here that the long-term development focus of the RAMP system is important, in that capacities that are important over the longer term can be targeted within warm-ups, even if they are not the focus of the current session. Over time, this allows for the development of key components of performance which may or may not be included in the upcoming session but which are crucial for athletic development. Again, the longer term thinking process is essential, allowing for extensive practice and development over time but without additional time or energy expenditure.[11]

Sessions can also be phased into the main session, so where the main session focuses on defensive skills, the potentiation phase can provide a sequenced and progressive range of activities that develop movements such as jockeying and acceleration, which are crucial to defensive capabilities, moving progressively onto more manipulative and sport-specific applications. This sequencing can move from discrete activities, through a series of combinations, and ultimately into the sport-specific applications the athletes will need to produce in the upcoming session.

Whether the sessions are predominantly discrete or phased, what is crucial for athletic development is that over a given period of time the athlete is exposed to activities that address all of the key movement capacities they require for performance. A powerful way to use the potentiation phase, and to ensure key capacities are developed, is the concept

‘Failure to include a potentiation phase will preclude peak performance’

of themed sessions. These themes can be single, combined, sports-generic or sports-specific. Single themed phases are where focus is on one movement capacity, such as acceleration, direction change, jockeying, etc. These are extremely useful when working with development athletes and are also useful when working on fundamental capacities such as acceleration. Combined themes are typically a progression from single phases. Here, movements are combined in typical combinations used in sport such as direction change and acceleration, jockeying and acceleration.

Sport-specific or sports-generic themes are a further progression, where tasks are progressively introduced that address typical sport-generic task requirements or sports-specific task requirements.[10] Here themes such as defensive skills, offensive skills, etc, provide sports-generic task-based themes, and these generic approaches can themselves be broken down into highly sport-specific task themes, such as defensive skills from set pieces.

Typically, the potentiation phase will involve an increase in intensity and can also involve an increase in specificity as it progresses. So, for example, an acceleration theme can initially focus on technical drills followed by accelerations from a standing start, progressing to accelerations from a range of rolling starts, and finishing with accelerations in offensive and/or defensive task based scenarios.

By optimal application of the potentiation phase, a significant volume of speed, agility and plyometric work can be carried out, which both prepare the athlete for the upcoming session, but significantly enhance the long-term athletic development of the athlete. Where this phase is used as preparation for performance it becomes a highly efficient way of ensuring a minimal volume of speed and agility training is incorporated into an athlete’s training programme. However, extending the potentiation phase is a powerful tool and a highly efficient way of including additional dedicated time for speed and agility development, where rather than have a dedicated session at a different time, the warm-up is extended to have a dedicated period of 10-15 minutes focused on speed and agility development prior to a timetabled session.[9]

Being at the start of the session, athletes are non fatigued and the RAMP has optimally prepared the athlete for high intensity performance. Here, the extension of the potentiation phase by 10 – 15 minutes allows for an optimal volume of high intensity speed and agility training to be carried out. Again the focus can be on a single theme or most commonly is of a progressive nature as outlined above.

Summary

The RAMP system is built around training effectiveness and efficiency. Its sequential nature ensures that each phase optimises performance in the subsequent phase. However, perhaps the most powerful advantage of the system is how it switches focus from mainly short-term considerations to a combination of short-term and long-term. By switching to a long-term focus, it allows activities to be selected that achieve the short-term focus but which also contribute to the long-term athletic development of the athlete. In this way, a significant amount of time can be devoted to the development of movements and locomotor skills, and also to the development of key capacities such as speed, agility and power. Critically, this is achieved without a significant increase in training time, maximising efficiency and ensuring an effective application of training.

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UKSCA and Rugby Football League Coach Education Programme

BACKGROUND TO THE PROGRAMME

A high level of interest in the UKSCA was registered among both professional and community coaches in rugby league: they were interested in both achieving accreditation and also in further learning courses in the areas of physical preparation. However, many of the rugby league coaches cited a lack of time, available budget or accessibility to courses as reasons for not actively pursuing UKSCA accreditation and education opportunities.

As a governing body, the RFL therefore decided to collaborate with the UKSCA to develop a programme to assist rugby league coaches, while insisting that certain professional standards were adhered to by practising coaches at club level. The key aim of the UKSCA/RFL Coach Education Programme was to facilitate accessible professional development for rugby league-based conditioning coaches in line with UKSCA competencies. This is a game-wide strategy, both to increase the quality of these coaches and also their delivery at all levels of club rugby league, thus potentially producing more world class players at England level.

> 'As a former player, I fully understand the need for support from the best coaches in athlete physical preparation. Investing in our coaches with the best possible content is vital for the future of the game. By working with the UKSCA we can ensure both coach and athlete development whilst ensuring best practice in player welfare.'
>
> **Kevin Sinfield, MBE**
> **RFL Rugby Director**

THE MODEL

An accessible collaboration, delivered at regional training centres:

- Specific: Nine three-hour sessions of learning per core component, from plyometric agility speed, programming, weightlifting, and pre-accreditation preparation (total of 30 hours)
- Accessible: Evenings from 18.00-21.00, running for four consecutive months on the first three Mondays of each month
- Cost-effective: Subsidised rate per person, with minimal travel costs for coaches. Individuals pay for UKSCA accreditation at the standard rate/ through standard channels
- Bespoke: Course content and focus areas customised by experienced tutors and RFL input, to maximise the participants' development
- Led by two UKSCA tutors (24 course places) or one UKSCA tutor (12 course places)
- The pilot-targeted current practising club or sport based S&C coaches with applied industry experience.

SAMPLE COURSE CONTENT

Week 1: Introduction and case study
Week 2: Weightlifting for sports performance
Week 3: Plyometrics, agility and speed
Week 4: Weightlifting for sports performance
Week 5: Plyometrics, agility and speed
Week 6: Case study progression
Week 7: Assessment preparation and individualised content.

NEXT STEPS

The initial cohort of coaches – having been through the education programme – is now looking to progress to UKSCA accreditation. To support this, the programme is expanding to run some evening assessment preparation sessions with small groups of coaches, led by a UKSCA tutor/assessor. Due to the nature of the UKSCA's competency-based assessment, the aim of these sessions is not to guarantee a 'pass' at the assessment, but rather to work with coaches to enable them to determine their own readiness for the assessment and to help to develop personal development plans where required.

> Providing and accessing impactful, industry recognised CPD is a challenge for all governing bodies and coaches. The partnership with the UKSCA has provided RL coaches with an accessible pathway to high quality personal development which compliments their applied skill sets. The unique nature and value of this model with direct transfer to player preparation cannot be understated.'
>
> **Richard Hunwicks**
> **RFL head of human performance**

The tactical athlete: optimising physical preparedness for the demands of combat

By ***Jonpaul Nevin,***
Help for Heroes, Tidworth

INTRODUCTION

Modern military operations place unique and intense physiological and psychological demands upon the soldier. In order to help adapt to and cope with such demands, a high level of physical preparedness must be seen as a fundamental requirement of all military personnel.[3] Indeed, the modern soldier needs to be more agile, more capable, more able to survive and more resilient than the enemy in order to ensure victory on the battlefield. Soldiers who are physically fit can be seen as a critical force multiplier. Not only do they demonstrate improved mission performance, but they may also be more resilient for both the physical and psychological demands of sustained military operations.[25,61] Furthermore, physically fit soldiers may be less susceptible to injury and demonstrate better physical and mental health over the long term than less fit individuals.[8,17]

Every soldier an infantryman first

Given the asymmetric nature of modern warfare and the growing limitations placed upon military resources including manpower, it can be strongly argued that every soldier must be viewed as an infantryman first, regardless of his/her role or trade. The primary role of the infantry soldier is to close with and engage the enemy in order to bring about his defeat via either dismounted or mounted close combat.[2] Given the extreme physiological and psychological demands of combat, it is clear that the modern soldier must be viewed and trained similarly to an elite level athlete, or – more specifically – a tactical athlete.[56]

Like traditional athletes, the tactical athlete requires an appropriately designed physical training programme which will optimise physical preparedness for the demands of combat. However, there are a number of noteworthy differences between the traditional athlete and the tactical athlete. Firstly, tactical athletes often have no scheduled start or end to an event as such; they require a continuously high baseline of physical preparedness. In addition, due to high tempo operational environments they must also cope with extended periods of physical activity with unpredictable periods of rest or recovery. Finally, the tactical athlete is also exposed to a multitude of acute and chronic stressors, which are both physically and psychologically demanding.

The occupational task demands to be experienced during combat operations are likely to be varied. Tasks can include sustained patrolling at relatively slow speeds, over varying terrain, while carrying loads ranging from 48-57 kg.[12,15,29,48] Contact with enemy forces can result in sudden and sustained physical demands such as rapid movement over short distances, negotiating obstacles, engagement of the enemy in close quarters combat, ammunition re-supplies and – potentially – the extraction of casualties while under fire. This may then be followed by a period of recuperation in the field before being tasked to do the same again repeatedly over an extended period.[12,14,15,16,45,48]

Negative impact of combat on physical and mental health

The very nature of sustained combat operations often involves soldiers being exposed to a multitude of stressors, which can negatively impact not only on their operational effectiveness, but also on their long term physical and mental health. Many factors have been demonstrated to impair both short- and long-term physical and cognitive performance, including the following: heavy load carriage, exertional fatigue, sleep deprivation, poor nutrition, high calorific energy expenditure, inadequate recovery, exposure to intense psychological stressors and environmental extremes.[9,24,39,40,41,44,57]

Castellani et al[9] observed that 72–84 hours of sustained military operations resulted in decreases in body mass, combat-specific task performance, and cognitive ability, as well as impaired thermoregulatory function. These findings are supported by Nindl et al,[44] who demonstrated that eight weeks of intensive military training designed to replicate the demands of combat resulted in a significant reduction in maximal lifting strength, lower limb power and body mass. Furthermore, Lieberman et al[39,40] established that sustained combat operation can result in a substantial degradation in cognitive performance, including vigilance, reaction times, marksmanship, mood states, memory and logical reasoning.

Table 1. Components of military physical fitness (adapted from Knapik et al[30])

CATEGORY	FITNESS COMPONENT	DEFINITION	EXAMPLE MILITARY TASK
Movement skills	Mobility	Range of motion achieved at a joint or series of joints	Freedom to move over, under or through varying obstacles
	Stability	Maintenance of equilibrium while stationary or moving	Maintenance of stable firing position
	Motor control	Ability to use the senses, such as sight or hearing, together with the body parts in performing motor tasks smoothly and accurately	Bringing a weapon system to bear and accurately engaging targets
	Speed	Ability to perform movements in any given direction as quickly as possible	Rapid movement between fire positions
	Agility	Ability to change the position of the entire body in space with speed and accuracy	Repeatedly negotiating obstacles
	Quickness	The ability to react to visual, auditory and kinaesthetic stimuli	Reacting to effective enemy fire
Strength	Muscular endurance	Ability to exert sub-maximal external forces for a short period of time	Repetitive manual handling tasks
	Maximal strength	Ability to generate a maximal external force	Standing from kneeling with heavy loads
Endurance	Power	Ability to exert maximal external force in the shortest period of time	Breaking down compound doors
	Aerobic capacity	Ability to maintain sub-maximal efforts for a sustained period of time	Sustained patrolling with heavy loads
	Anaerobic capacity	Ability to sustain maximal efforts for a short period of time	500m casualty extraction

Anecdotal reports from recent conflicts suggest that soldiers frequently exhibited negative alterations in body mass and physical performance as a result of sustained combat operations.[12,15] However, to date only two studies have investigated the long-term effects of sustained military operations on soldier physical characteristics. Sharp et al[59] reported that a nine-month operational deployment of US Army personnel to Afghanistan resulted in a significant reduction in aerobic capacity, upper body power, body mass and fat-free mass. Interestingly, lifting strength and vertical jump performance was maintained over the period of the deployment.

Conversely, Lester et al[41] demonstrated that after a 13-month deployment to Iraq, soldiers' body mass and strength increased, while aerobic capacity declined substantially. The authors suggested that the lack of change observed may have been due to the fact that the soldiers used in this study were not frequently involved in combat due to their unit's operational role. As such, these findings must be interpreted with caution.

Although future military operations remain relatively unknown, success will most likely be influenced by the physical capability and performance of the individual soldier. Therefore, it is clear that optimising the physical preparedness of the soldier is essential in order to enhance their overall operational effectiveness and minimise the likelihood of injury, defeat or even death. The British Army defines military physical fitness as: 'The ability to respond instantly and effectively to the physical and psychological demands of combat over prolonged periods with the minimum of distress, and return to a normal healthy state once the demand ceases.'[3] Similarly, the US Army defines physical readiness as: 'The ability to meet the physical demands of any combat or duty position, accomplish the mission, and continue to fight and win.'[16]

Given the nature of these definitions, it is clear that the modern soldier requires a broad spectrum of physical capabilities in order to ensure optimal combat effectiveness. Table 1 gives the reader a brief overview of the various movement skills, strength, and endurance fitness components required by the tactical athlete, with practical examples of their application within the context of military specific tasks.

In addition to a high level of physical preparedness, the modern soldier must also be resilient to the psychological demands of combat. This requires a view of performance which encompasses the optimisation of the physical, cognitive and emotional traits of the soldier to create a more dominant warrior.[8]

Within this holistic view, resilience can be defined as the mental, physical, emotional and behavioural ability to face and cope with adversity, adapt to change, recover, learn and grow from setbacks.[8,13,17] Without

'The very nature of sustained combat operations often involves soldiers being exposed to a multitude of stressors'

'The overarching objective for the modern soldier should be to move further, move faster and fight harder than his enemy'

resilience, the soldier can easily become overwhelmed, by the various stressors which they may experience, resulting in a negative impact upon not only operational effectiveness, but also on long-term physical and mental health. Numerous studies have demonstrated the inter-related nature of physical fitness and mental resilience.[58,62] As such, it can be contended that appropriate physical training may also confer psychological benefits, which enable soldiers to become more resilient to the mental demands of combat via a process of systematic stress inoculation.[17,58]

Excessive focus on muscular endurance and aerobic capacity

Although it is clear that a broad spectrum of physical capabilities is required by the modern soldier, it can be strongly argued that for many years military physical training (PT) has been predominantly focused upon the development of muscular endurance and aerobic capacity. Indeed, traditionally, fitness within many militaries has been regarded as the ability to complete endurance-based activities, with little emphasis given to the development of either movement skill or strength fitness components.[61,66] This focus upon the development of endurance fitness component has resulted in the neglected development of movement skills, strength and power,[6,36,65] thus potentially impacting upon overall combat effectiveness.

Non-functional overreaching

Soldiers often judge themselves and others on their ability to withstand extreme endurance challenges which – when combined with poor nutrition, inadequate recovery, poor sleep hygiene and a host of other stressors – can result in the development of non-functional overreaching.[5] The human body can cope with being placed into an overreached state without suffering any adverse effects. However, continued long-term exposure can result in decreased physical performance,[5] an increased likelihood of musculoskeletal overuse injury,[4,63] and potentially serious long-term physical and mental health consequences.[5]

It is highly questionable whether or not current military PT practices adequately prepare soldiers for the demands of combat.[42,43] Indeed, reports from both commanders and soldiers alike support this contention, with many questioning the efficacy of current military PT methodologies and testing protocols in relation to the extreme physiological and psychological demands encountered during sustained combat operations.[12,15,43] Furthermore, anecdotal evidence suggests that – more often than not – military PT is routinely ad-hoc in nature, with training geared towards the completion of mandatory, non-task-specific fitness tests, with an emphasis placed upon testing statistics rather than real world physical

performance.[43,61] Finally, it has also been suggested that the nutritional, recovery and sleep hygiene behaviour of military personnel is at best inadequate, negatively impacting upon not only physical preparedness, but also long-term health and well-being.[8]

New direction for training required

Given the identified issues with current military PT practices, it is clear that a new direction is required in order to optimise physical preparedness, minimise the likelihood of injury and improve the long-term health and well-being of the modern soldier. In order to achieve these objectives, it is recommended that a flexible, evidence-based, PT programme be adopted. Such a programme needs to be grounded upon the fundamental training principles of specificity, overload, recovery, progression and reversibility.[36] In addition, it must allow for the concurrent development of movement skills, strength and endurance fitness components. Furthermore it must also include an element of military occupational task-specific training and be based upon a suitable model of periodisation, a model which organises training into systematic cycles of undulating intensity and volume: this is necessary in order to reduce the accumulation of chronic fatigue, mitigate the risk of overtraining and optimise subsequent physiological adaptations.[36] Finally, it must also be flexible enough to meet the fast tempo and ever-changing demands of unit training cycles and multiple operational deployments.[1,37,59]

Numerous studies have established that periodised training programmes incorporating concurrent strength and endurance training can significantly enhance military task-specific performance, while also decreasing the likelihood of injury. In comparison to either strength or endurance training alone, concurrent training programmes have been demonstrated to improve load marching performance,[19,23,31,34,35,55,65] material manual handing ability,[23,34,65] and also lower body strength and power,[1,23,59] as well as obstacle course performance[19,23] and simulated casualty extraction timings.[19,23,59]

Evidence suggests that concurrent training regimes may interfere with the development of maximal strength and power.[67] However, given that the tactical athlete requires a broad spectrum of physical capabilities, any potential interference effect on the development of maximal strength and power can be seen as an acceptable trade-off due to the significant enhancement in military task specific performance observed as a result of concurrent training.[1,19,23,31,34,35,55,59,65] Furthermore, careful and balanced programme design may help to minimise the impact of any potential interference effect.[18]

Daily undulation periodisation

The use of a daily undulation periodisation (DUP) has been proposed by several authors as being suitable for both team sports and military populations due to its inherent flexibility.[24,37,47,61] DUP can be characterised by a daily, wave-like, alternation of training loads (intensity x volume) and/or training modalities dependent upon the focus of a specific training block within which sits the session.[52] The fundamental basis behind DUP is that one can have a different training session each day, which provides not only a different physiological training stimulus but also allows for adequate management of acute fatigue between sessions.

In comparison to linear and non-periodised training models, DUP has been proposed to offer equal, if not greater, improvements in physical performance.[20,21,22,33,54] The progressive overload of a given motor attribute during DUP is not achieved on a day-to-day basis as the training stimulus is too varied. As such, progressive overload is achieved during a subsequent training session with a similar focus. It can be argued that DUP may take longer to stimulate specific adaptive changes, due to an insufficient frequency of training on any given fitness component.[11,50,51] However, the use of a conjugated block approach, incorporating DUP, may potentially offset this problem.

A conjugated block approach places an emphasis upon the highly concentrated development of a specific set of motor attributes during a given training block, while simultaneously maintaining other motor attributes albeit at a reduced training volume.[27,28] The sequencing of conjugated training blocks is intended to build upon the residual training effects of previously developed motor abilities. Therefore, it is proposed that the use of DUP within a conjugated block model may provide a sufficiently adequate training stimulus in order to elicit the required physiological adaptations. Theoretically, a training programme based upon a conjugated

'Evidence suggests that concurrent training regimes may interfere with the development of maximal strength and power'

block model incorporating DUP could be developed in line with a unit's yearly training plan and/or upcoming operational deployment cycle; this would help to optimise the physical preparedness of the soldier for a specific deployment.

Typically, a training block is divided into a series of training weeks which are defined as being either accumulating or unloading in nature. Accumulation training weeks can be characterised by a planned increased in the training load in order to provide a suitable training stimulus in line with the overall training block objective. In contrast, an unloading training week can be defined by a marked reduction in the training load, in order to reduce the accumulation of chronic fatigue, mitigate the risk of overtraining and optimise subsequent physiological adaptations. From a planning perspective, operational deployments can be viewed as the peaking phase of a training programme. Therefore, based upon identified time constraints and competing unit training demands, different training block configurations (3:1, 2:1, 1:1) can be easily adopted in order to allow for suitable windows of opportunity for training and recovery.

'Operational deployments can be viewed as the peaking phase of a training programme'

Hybrid/extreme conditioning programmes

Hybrid training or extreme conditioning programmes are extremely popular within the military due to their inherent variation, challenging nature and efficient use of time.[10,32] In addition, hybrid training also has strong military cultural connotations, as workouts of the day (WODs) are often named in honour of fallen comrades as an act of remembrance. Hybrid training typically blends movement skill and strength and endurance fitness components into a single training session; WODs are often based upon the completion of a set amount of work or alternatively the completion of as much work as possible within a given time frame using consistently varied multiple joint exercises.[10,32]

Several studies have demonstrated that hybrid training modalities can enhance military task-specific fitness.[26,49] Indeed, hybrid training has been successfully incorporated within the physical training doctrines of both the Canadian and US militaries.[7,49,53] However hybrid training may pose an increased risk of injury due to potentially poor exercise technique and/or a loss of form due to excessive fatigue.[32] Furthermore, hybrid training has been linked to the onset of overtraining syndrome and rhabdomyolysis.[32] Nonetheless, hybrid training modalities offer a novel training stimulus which may enhance the overall physical and psychological preparedness of the modern soldier for demands of combat.

Military occupational task-specific training – commonly known as battle PT – is essential in order to provide the required element of specificity needed to ensure optimal physical preparedness to meet any likely mission requirement which may be experienced during combat. To coin a British Army saying: 'train as you fight'. Battle PT has been demonstrated to enhance combat-specific fitness measures.[26,31,46,60] Examples of battle PT include sustained heavy load carriage, material manual handling, burden carries, simulated casualty extractions, fire and manoeuvre drills, combatives and obstacle courses. It is important to note that the intensity and volume of battle PT should be systematically increased until the likely demands of combat are replicated. In addition, the incorporation of mission essential equipment – including body armour, helmets, load carriage equipment and weapon systems – should be gradually introduced so that the soldier is able to meet the demands of the anticipated worst case and mission-related scenarios without excessive difficulty or exhaustion.

Physical and psychological preparedness

Based upon the literature reviewed, one can infer that a concurrent training programme based upon a conjugated block model incorporating DUP may optimise not only the physical but also the psychological preparedness of the soldier for the demands of combat. Such a programme needs to simultaneously develop movement skill, strength and endurance fitness components. In addition, it must also include hybrid training and battle PT sessions in order to provide the required element of task-specificity indicative of any effective training programme. Furthermore, the development of performance-enhancing behaviours – through appropriate educational interventions in areas such as nutrition, mindset, movement preparation, recovery and sleep – may also help to optimise the physical preparedness and long term health and well-being of the tactical athlete.[8]

Tables 2, 3 and 4 give an example of a 12-week training programme split into three, four-week training blocks designed to prepare the solider for a specific operational deployment. Each training block progressively builds upon the last, with the training load gradually increasing. In addition, as the programme progresses, the overall emphasis becomes more combat-specific with the overall frequency of battle PT sessions increasing.

It should be noted that this is merely an example training programme and that the number and length of each training block will be dictated by the available training time. Furthermore, it should be noted that the sequencing of training sessions should not be set in stone. DUP's strength is its inherent flexibility. Therefore, daily training sessions should be adapted, based not only on a soldier's conditional readiness to train, but also on other conflicting unit training demands.

The demands of combat, combined with a lack of opportunity to train, dictate that the goal of PT during operational deployments should be to maintain physical preparedness. Furthermore, physical activity while deployed can be an important respite from the stresses of operations and an essential part of a soldier's routine.[3]

A continuous DUP approach utilising hybrid training modalities may be the best option while deployed, due to its adaptability to fit around operational demands such as high mission tempo, fatigue and sparse base conditions. Upon return from an operational deployment, it is vital that a period of rest and recovery be implemented, in order to allow the soldier to recover and regenerate from the physical and psychological demands of sustained operations. This period should be characterised by low-intensity, low-volume active recovery modalities including both sport and adventurous training. This in turn will help the soldier to recover in preparation for future training and operational deployment cycles.

Summary

It is clear that military operations place unique and intense physiological and psychological demands upon the soldier. The overarching objective for the modern soldier should be to move further, move faster and fight harder than his enemy in order to bring about his defeat. Fundamentally, the soldier is a system: in order to optimise the effectiveness of that system, the soldier must be trained as an athlete, with as much time, effort and resources placed into developing the soldier system, as they would be with any other weapon system.

This article purposely does not go into depth regarding military fitness testing or specific training methodologies as its aim is to help drive a discussion on the development of

'Hybrid training modalities offer a novel training stimulus'

a holistic, evidence-based approach towards future military PT.

Policy makers, the chain of command, PT staff and the individual soldier must all come to realise the interdependent relationship between physical preparedness, overall operational effectiveness and long-term physical and mental health. Failure to do so will result in the soldier being ill-prepared for the demands of combat, ultimately impacting upon overall mission readiness, operational effectiveness, and general long-term health and well-being.

Table 2. Training Block One: Accumulation

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Week 1	Muscular endurance: lower body; 4 sets of 8 reps; rec 1 min	Aerobic training	Strength: total body; 5 sets of 5 reps; rec 2 mins	Anaerobic interval training	Muscular endurance: upper body; 4 sets of 8 reps; rec 1 min	Rest	Rest
Week 2	Strength: lower body; 5 sets of 6 reps; rec 2 mins	Movement skills/ hybrid training	Muscular endurance: total body; 4 sets of 8 reps; rec 1 mins	Load carriage training: 6 km /20 kg	Strength: upper body; 5 sets of 6 reps; rec 2 mins	Rest	Rest
Week 3	Muscular endurance: lower body; 4 sets of 10 reps; rec 1 min	Aerobic training	Strength: total body; 5 sets of 7 reps; rec 2 mins	Anaerobic interval training	Muscular endurance: upper body; 4 sets of 10 reps; rec 1 min	Rest	Rest
Week 4	Active recovery	Movement skills/ hybrid training	Active recovery	Movement skills/ hybrid training	Active recovery	Rest	Rest

Table 3. Training Block Two: Transition

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Week 1	Strength: lower body; 5 sets of 5 reps; rec 2 mins	Anaerobic interval training	Maximal strength/power: total body; 6 sets of 2 reps; rec 3 mins	Movement skills/ hybrid training	Strength: upper body; 5 sets of 5 reps; rec 2 mins	Rest	Rest
Week 2	Maximal strength/ power: lower body; 6 sets of 3 reps; rec 3 mins	Load carriage training: 7 km / 25 kg	Strength: total body; 5 sets of 6 reps; rec 2 mins	Anaerobic interval training	Maximal strength/ power: upper body; 6 sets of 3 reps; rec 3 mins	Rest	Rest
Week 3	Strength: lower body; 5 sets of 7 reps; rec 2 mins	Battle PT: obstacle course/ combatives	Maximal strength/power: total body; 6 sets of 4 reps; rec 3 mins	Load carriage training: 8 km/30kg	Strength: upper body; 5 sets of 7 reps; rec 2 mins	Rest	Rest
Week 4	Active recovery	Movement skills/ hybrid training	Active recovery	Movement skills/ hybrid training	Active recovery	Rest	Rest

Table 4. Training Block Three: Realisation

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Week 1	Maximal strength/ power: lower body; 6 sets of 2 reps; rec 3 mins	Movement skills/ hybrid training	Strength: total body; 5 sets of 5 reps; rec 2 mins	Load carriage training: 9 km/35 kg	Maximal strength/ power: upper body; 6 sets of 3 reps; rec 3 mins	Rest	Rest
Week 2	Strength: lower body; 5 sets of 6 reps; rec 2 mins	Battle PT: fire & manoeuvre drills/combatives	Maximal strength/power: total body; 6 sets of 3 sets; rec 3 mins	Movement skills/ hybrid training	Strength: upper body; 5 sets of 6 reps; rec 2 mins	Rest	Rest
Week 3	Maximal strength/ power: lower body; 6 sets of 4 reps; rec 3 mins	Load carriage training: 10 km/40 kg	Strength: total body; 5 sets of 7 reps; rec 2 mins	Battle PT: combatives/ casualty extractions	Maximal strength/ power: upper body; 6 sets of 4 reps; rec 3 mins	Rest	Rest
Week 4	Active recovery	Movement skills/ hybrid training	Active recovery	Movement skills/ hybrid training	Active recovery	Rest	Rest

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Jonpaul is the lead strength and conditioning (S&C) coach at Help for Heroes, delivering S&C support for wounded, injured and sick service personnel and veterans on performance sport pathways. He is a fully accredited member of the UKSCA. Prior to joining Help for Heroes, Jonpaul served in the British Army for 15 years, seven of which were spent in the Royal Army Physical Training Corps, working as an exercise rehabilitation instructor. He currently specialises in the delivery of S&C support for disabled athletes across a wide range of paralympic sports including cycling, powerlifting, surfing, triathlon, skiing and athletics. He is also undertaking an MSc in strength and conditioning at St Mary's University and has a keen interest in developing physical preparedness of military populations based upon his previous service experience.

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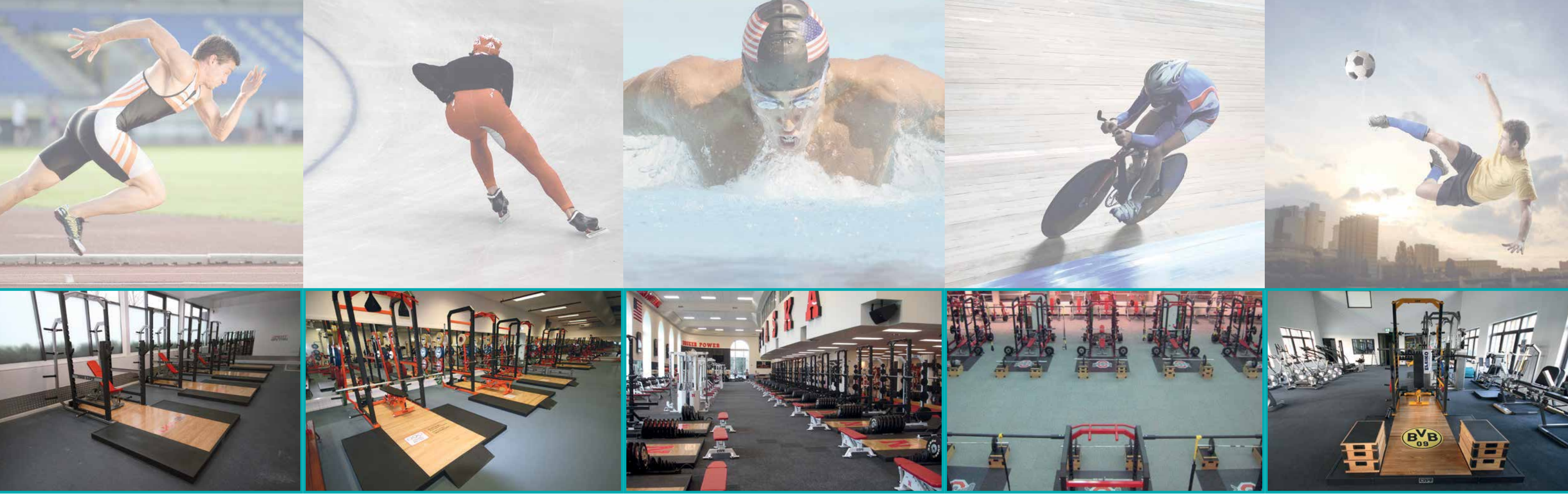

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