Pearson

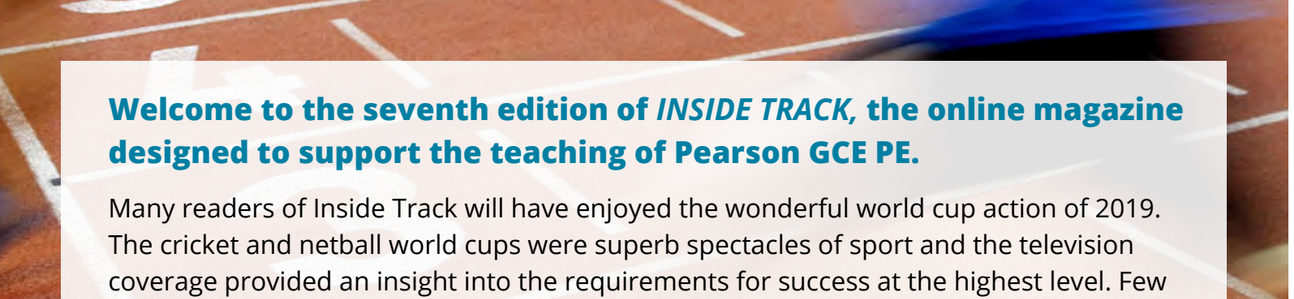
INSIDE TRACK

Online magazine designed to support the teaching of Pearson GCE PE | January 2020

Is warming up important?

Also in this issue:

Principal Examiners feedback
Respiration and Ventilation
Priming exercise
Understanding Schema Theory



Welcome to the seventh edition of *INSIDE TRACK,* the online magazine designed to support the teaching of Pearson GCE PE.

Many readers of Inside Track will have enjoyed the wonderful world cup action of 2019. The cricket and netball world cups were superb spectacles of sport and the television coverage provided an insight into the requirements for success at the highest level. Few people who watched the final of the cricket will forget the excitement of the last few minutes which offered one of the greatest climaxes of international sport of all time.

Hopefully, the 2020 Olympics in Japan will be another glorious spectacle of sport.

Included in this edition of Inside Track is an in-depth article on priming exercise by the Chair of Examiners Phil Hayes, together with pieces on a number of other important areas of the specification. We hope you find this edition helpful to your teaching and learning.

Get in touch

It is hoped that INSIDE TRACK will be a helpful resource for centres delivering the Pearson specification. If you have particular requests for how the magazine can support you, or wish to contribute, then please contact the editorial team at insidetrackpearson@hotmail.com or teachingpeandsport@pearson.com.

Support materials

Topic guides, which provide additional detail about the content requirements of the specification, sample assessment materials, coursework examples and other useful resources to support the delivery of the course are available here.

Past issues

Did you miss an issue? Need to catch up? Just now discovered us and wondering what you missed? You can browse through the past editions of Inside Track here.

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INSIDE TRACK is produced by Dennis Tattoo, Penny Lewis and Steve Tutt.

Feedback from 2019 AS examinations

The senior examiners, detailed below, offer the summaries of what can be learned from the examinations in 2018. Copies of the full reports are available from the Pearson website.

8PE01 – Scientific Principles of Physical Education

Principal Examiner Dee Gannon summarises the key points from the 2019 examination.

Overall, candidates showed a better understanding of key terminology, although candidates still need to ensure they understand what is expected of the command words, as some marks were lost for not linking answers.

Most questions showed a good spread of marks with only two questions where candidates struggled; these were question 10 (determinants of sprinting) and question 15 (PNF stretching).

The longer questions showed an improvement on the last series in terms of accessing more AO3 marks and were written in a far more logical manner.

Few candidates are still accessing top band marks due to lack of detailed analysis and conclusion or, in the case of the asterisked (*) question, still not including content from across the specification.

Centres and candidates are encouraged to continue to make good use of Inside Track and the topic guides to ensure candidates are aware of the expected depth and use of language.

8PE02 – Psychological and Social Principles of Physical Education

Principal Examiner Andrew Armitstead outlines the important points emerging from the 2019 examination, and offers some specific advice about the importance of understanding how answers should reflect the command word used in the question.

Many candidates wrote very good answers in this examination, building on the previous series.

Extended writing questions worked best when candidates responded to the individual demands of the command word and recognised that there are differences between the demands of analyse and discuss.

An analysis question requires students to examine something methodically and in detail, typically in order to explain and interpret it. To score in the top band, a supported judgement was required, and this was done very well by many candidates as it was a familiar topic (coaching styles) and data was provided to allow a methodical and reasoned examination.

To discuss an issue on the other hand, requires an exploration of issues, lines of reasoning and situations and articulating different viewpoints.

It is essential, therefore, that students include different viewpoints in their answers.

In the case of question 11, these could include negative factors of colonialization or factors outside of the Empire's influence that contributed to the development of international sport. The substantiated judgement should focus on the extent to which the British Empire influenced international sport's development

For longer questions that are allocated more marks, students must ensure they provide the required number of points to score the maximum mark.

For a 'summarise' question, this means to express the most important facts or ideas about something, and students should aim to write up to two/three paragraphs. For question 4 on Thorndike for example, students would be expected to express important factors regarding all three laws and aim to make at least six separate points. Question 10 was also a summarise question requiring a minimum of six distinct points.

For an 'explain' response, the student is required to provide detail regarding the 'how' and/or 'why' and meaning of something with reasons. Examples can be used to enhance the quality of an explanation, but points need to be linked to score marks. Question 5 asked students to explain the causes of aggression requiring them to state how over-arousal, under-developed moral reasoning and bracketed morality caused aggressive tendencies.

An 'examine' question is slightly more complex requiring a justification or exemplification of a point using analysis or evaluation. Question 9 referred to the impact of urbanisation necessitating a minimum of six points examining the positive and negative impacts of urbanisation.

The judgement made was reflected in the categorising of the impact as positive or negative. It is important to consider here that some points could have both a positive and negative impact. Urbanisation contributed to growth of factories which was positive, in that this formed communities that took sport to their hearts but also negative, as a result of the increased levels of pollution and detrimental effects on health.

The aim in writing an exam paper is to ensure equal coverage over the specification. It is vital that students access the specification in its entirety and do not approach the exam with gaps in knowledge.

The new content remains an area for further refinement and students must ensure they are equipped with the skills to answer a question on any area of the specification.

Students should also try to order their understanding to avoid confusion between topics, for example, Wood's and Hollander, or Thorndike and Fitts and Posner. A good way to avoid this is through the inclusion of retrieval tasks in teaching to ensure that firm understanding is embedded in long term memories. Making students focus on their learning from the last lesson, last week, last month and even last year enables them to practise retrieving information that will be useful in exams.

Where examples are required these should be as specific as possible and related to sport. 'Being aggressive' is an example of aggression but it is too vague. Committing a high tackle in rugby is a better example but Roy Keane's tackle on Alfie Inge Harland where he, allegedly and depending on what sources you read, broke his leg and ended his career, is far more specific.

8PE03 – Practical Performance

Principal Moderator Dane Smith assesses the practical assessments for the AS specification for the 2019 series.

The vast majority of centres continue to assess the practical component in line with the specification requirements with most marks being within the top two-mark bands.

Live moderations were organised very well, candidates were motivated and took pride in their performance. There was an improvement with more appropriate dynamic practices being used, however some centres are still including static and/or basic practices. In order to fully justify marks awarded, especially in the top two bands, centres should include conditioned practices that reflects their performance level.

Some centres conducted a formal competitive situation during the live moderation, while others showed conditioned practices live and submitted DVD footage for the competitive aspect.

This was used effectively for candidates who performed at a higher level, and centres are encouraged to use the most appropriate method for assessment to allow their candidates to fully demonstrate their ability. However, there were some issues with DVD moderation due to candidate identification and certain camera angles, although there was an improvement from the previous series.

Footage that was set above the level of the performance proved to be a more effective angle than at ground level. The majority of evidence submitted was not edited, although there are still some centres submitting edited footage.

This is not appropriate, and all evidence submitted must be unedited in order to meet the specification requirements. Please refer to the FAQ's guide.

Timeline for hockey match

Match v An Other H S 23 March 2019
Draw 2 – 2
First half timeline

2: tackle to gain possession of ball with accurate pass down the line
5: overlapped to receive forward pass and crossed to the top of the circle
6: missed tackle
9: played 1-2 to create shooting chance
11: intercepted pass on half way line and played square pass
14: shot from just inside the circle – saved
17: shot from wide angle – missed target; should have gone across the keeper
21: missed tackle; didn't balance off early enough
25 - 26: played three passes in rapid succession, all go to intended target
29 - 30: four short passes in defensive third; one intercepted by opponent

Centres are also reminded that a storyboard/timeline like the one above should be submitted with any DVD submission that outlines the candidate's involvement. This is especially the case for games activities.

Very few candidates chose coaching, however, many of those that did performed to a good standard. In most cases the candidates assisted with school teams or after school clubs and were confident in their ability, although areas that need some improvement include:

1. Some candidates just simply organised drills rather than demonstrating their ability to coach. Restricted numbers in the assessment session could assist with this.

2. Most candidates did not include evidence of a competitive situation which is a requirement. Centres are reminded that on page 224 of the Practical Performance Assessment Criteria, 'Students will be assessed on their ability to coach effectively through the planning, organisation and delivery of coaching sessions to an individual, group or team while under observation in conditioned practice and a formal/competitive situation'.

8PE04 - Performance Analysis

General comments

The majority of work submitted was assessed within Level 3 (7-9 marks) for both tasks, although there was an increase in the number of candidates awarded marks in the Level 4 band (10-12 marks).

Physiological

The majority of candidates were able to identify and give some application of the three most appropriate components of fitness, but they were not always justified. Top band candidates were able to research the overall physiological requirements for their sport, and then make sound judgements regarding the three most important fitness components from this research.

This is excellent practice and all candidates should be encouraged to do this rather than simply stating the important fitness components that is not supported by appropriate external sources.

Some candidates are still referring to **health-related** and **skill related fitness components** and including generic definitions that are not directly related to the task. Likewise, candidates are still using the term '**cardiovascular fitness**' where more appropriate terminology such as aerobic capacity/fitness is more appropriate.

Higher marks are awarded to candidates who have demonstrated that they have researched the specific tests and standards required to perform at a more elite level in their activity.

However, there is still an over reliance on generic based tests and normative data from websites such as **brainmac.co.uk** and **topendsports.com** which creates problems in terms of validity.

This is still an issue and candidates are still choosing generic tests such as:

- Stork balance test
- 12-minute Cooper run
- Alternate hand ball throw
- Ruler drop test

With regards to validity and reliability, most candidates were able to define or describe the terms, although greater emphasis is needed in order to provide direct and relevant explanations in relation to the candidate's activity.

Also, some candidates did not fully distinguish between the two terms, and quite often information supplied for reliability was more relevant for validity (or vice versa).

Higher ability candidates were able to give in depth justification for each test in terms of validity and provide clarity with regards to reliability.

In some cases, candidates were able to identify and explain more valid tests that could be used, especially when the test conducted lacked validity, although centres are encouraged to utilise the most valid tests if possible.

The task should be completed by outlining future training priorities as a result of the analysis of strengths & weaknesses that considers a range of quantitative evidence regarding recommendations for future improvement.

This could include relevant research and/or the inclusion of supporting evidence and comments from a coach or higher-level performers in the form of a witness statement.

This section of the task needs more attention from most candidates.

Technical

The technical analysis was the favoured option for the second task. In most tasks, presentation of photos of the candidates and elite performers performing their selected skill through the three phases of preparation, execution and recovery was good.

Annotations were used throughout these tasks as well, however candidates need to analysis the differences between theirs and the elite performers technique in more detail, rather than giving a descriptive report to achieve higher marks.

Some candidates only included biomechanical aspects, and although this is important, it must be balanced with technical information. This then can be supported by external sources such as technical journals and National Governing Body website material.

Tasks that were assessed in Level 4 generally included input from a coach or mentor. Candidates were able to use this information in the analysis to justify strengths and weaknesses (evidenced through a witness statement).

Some candidates also included a notational exercise that provided valuable data for the analysis that compared the application of their skill in comparison to an elite performer. This allowed candidates to evaluate their strengths & weaknesses in greater depth.

Tactical

The candidates who submitted a tactical analysis did so to a good or to very good standard. Appropriate tactics with clear explanations and purpose of application were included in most tasks.

Annotated images were utilised effectively, illustrating how the tactic is formed, executed and adjusted to a changing environment.

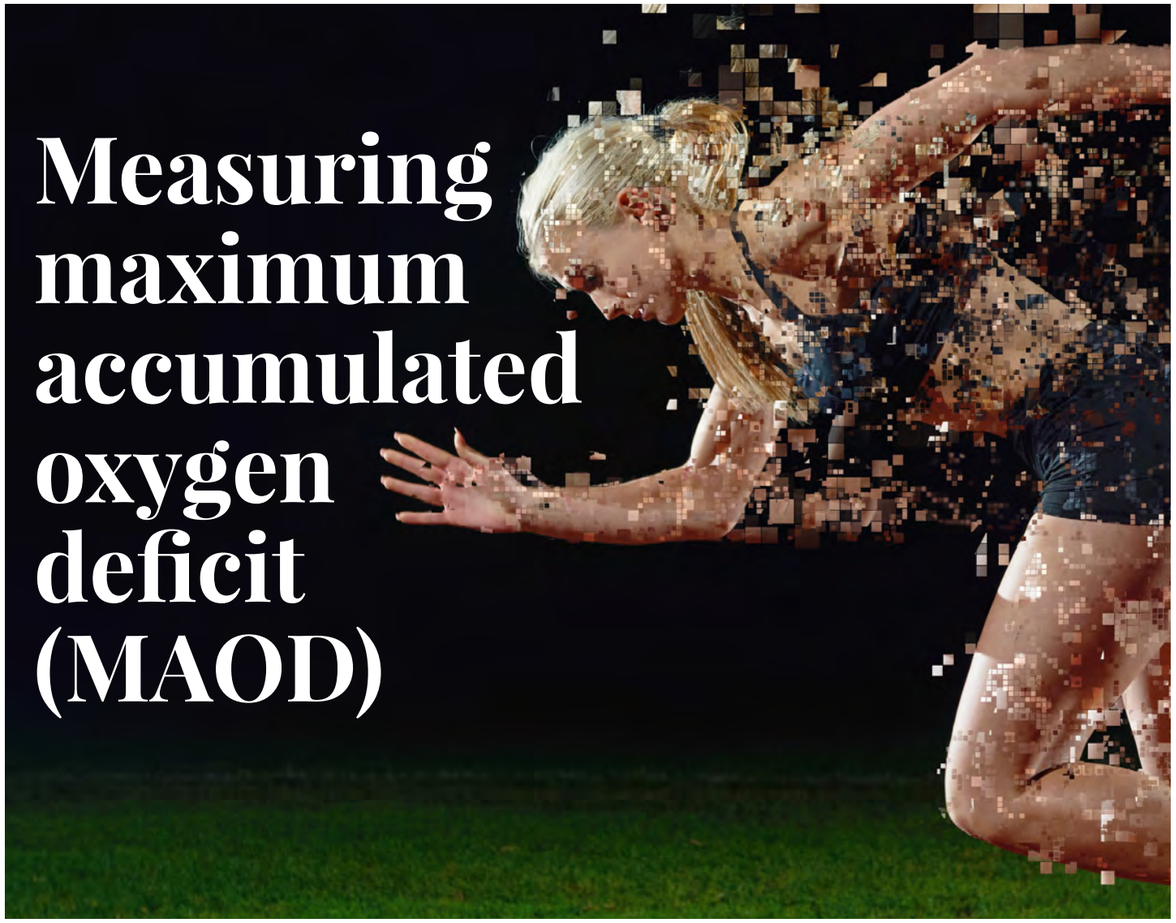
Higher ability candidates were able to compare the success of the tactic from their own experience with more elite examples that included substantial quantitative data in the form of a notation or a witness statement to support qualitative comments.

Some candidates also included video clips of both theirs and elite performances to support the analysis provided.

Top band tasks included more depth of information with regards to how the tactic could be adjusted as a result of changing circumstances, and it was clear that candidates had a good understanding of their activities.

Overall the tactical analysis was completed very well, and centres are encouraged to revise their approach to the optional tasks, as some candidates may be more comfortable completing a tactical analysis.

Measuring maximum accumulated oxygen deficit (MAOD)



Chair of Examiners Phil Hayes summarises how the MAOD test can be used to measure anaerobic capacity.

Maximum accumulated oxygen deficit or MAOD as it is usually referred to, is the gold standard measure of anaerobic capacity. Before looking at how it is measured, it is perhaps worth re-capping anaerobic capacity.

What is anaerobic capacity?

Anaerobic capacity is a bit like a reserve fuel tank. When the aerobic energy system cannot work fast enough to supply all of the energy required for the activity i.e. when the intensity is above the maximum steady state, the anaerobic system makes up the short fall.

This use of the anaerobic energy system drains the anaerobic capacity and if the activity continues for long enough the anaerobic capacity will run out and the person reaches the point where they have to stop.

The higher the exercise intensity is above the maximum steady state the faster the anaerobic capacity will be used up.

In activities where there are repeated sprints, the anaerobic capacity is partly, or fully, replenished between sprints, depending on how much anaerobic capacity was used up and the length of recovery.

Measuring MAOD

This is done in a laboratory, usually on a treadmill, with expired gases ($\dot{V}O_2$) measured throughout. The treadmill speed is set at an intensity above the maximum steady state, so that the anaerobic capacity has to be used. A lot of research has used intensities above $\dot{V}O_2$ max e.g. 120% of $\dot{V}O_2$ max, to ensure the activity is long enough to exhaust the anaerobic capacity but not too long that the person becomes bored.

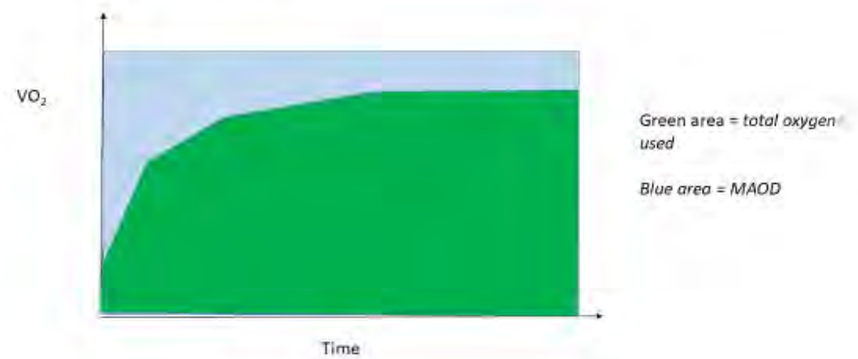
The test is performed at a constant speed until the person reaches the point of exhaustion. From a prior incremental test, it is possible to know how much oxygen that person would require at any given running speed (or cycling power).

Multiplying how much oxygen would be required at the test speed by the time the test lasted gives a value for the total oxygen requirement of the test i.e. how much oxygen would be required to do the exercise only using aerobic energy (Fig 1 – blue area). From the expired gases measured during the test, it is possible to calculate the total oxygen consumed during the test (Fig 2 – green area).

The MAOD (Fig 2 – blue area) is the difference between the total oxygen required and the total oxygen consumed i.e. the amount of energy supplied by the anaerobic system. The MAOD is therefore considered to be a measure of the anaerobic capacity.

Fig 1 – MAOD – total oxygen required

Fig 2 - MAOD



Colonial diffusion across the British Empire, and how this led to the creation and development of international sport

Principal Examiner Andrew Armitstead outlines some of the key learning linked to the role of the British Empire in influencing international sport.

Facts about the Empire

- Lasted from 1583 to 1997 (though it could be argued it is still in existence today)
- At the peak of the Empire, in the early part of the 20th century, it spread across 25% of the World, making it the largest empire in history
- Until 1783, Britain owned the original thirteen colonies in what is now the USA
- The Empire encompassed parts of Europe, North America, Australasia, Africa and Asia
- 63 countries have gained independence from the Empire but Britain still owns some small island territories such as Gibraltar, the Falklands and Bermuda

Facts about international sport

- 1844 – first international fixture – Canada v USA (cricket)
- 1871 – Scotland v England rugby union
- 1872 – Scotland v England football
- 1877 – first test match cricket England v Australia (Ashes date back to 1882)
- 1896 – first modern Olympic Games in Athens
- 1930 – first Commonwealth Games
- 1930 – first Football World Cup
- 1954 – first Rugby League World Cup
- 1975 – first Cricket World Cup
- 1983 – first World Athletics Championships
- 1987 – first Rugby Union World Cup

Sport and colonialisation

Values and morals were spread across the Empire through sports. Sport provided opportunities for leisure, community, entertainment and training for armed forces.

The values of public schools were shared with native populations by young men who had travelled across the Empire as officers, teachers, missionaries, administrators or Governors.

Head teachers at the English public schools actively prepared boys for roles in the Empire where they used team games to foster values such as endeavour, respect, leadership, fitness and team work. Sport developed social cohesion but also served as a reminder of status.

Cricket was the most significant sport as it could be played in all the colonies (unlike rugby or football) and cricket was the dominant English sport when the Empire was at its peak. In India cricket encouraged the support of local elites in a nation where 1,000 civil servants ruled over a population of nearly 300 million.

School systems across the Empire were based on the public schools in England and had team games at their hearts.

It was from this basis that international sport was launched at the end of the 19th century and international tournaments developed in the 20th.

Activities for students

1. **Research a case study for the development of a sport in a Commonwealth country e.g. Rugby in South Africa.**
2. **Examine the founding of each international tournament and assess whether this was a by-product of colonialisation or a result of other factors.**
3. **Discuss how the Olympics of 1896 was influenced by the British Empire.**
4. **Identify reasons for the popularity of British games in Commonwealth countries such as cricket in southern Asia and rugby in New Zealand.**

Feedback on the A Level Examinations

9E01 – Scientific Principles of Physical Education

Principal Examiner Ellie Bunston identifies the key points emerging from this paper in 2019.

This summer many candidates performed well on the content that has featured in previous specifications.

Those centres who have been utilising the Inside Track publication and the topic guides to support their understanding appear to have performed better on the new content areas.

However, too many candidates are not utilising all the resources available and do not have enough knowledge of the new topic areas. This was especially evident in the questions on priming exercise, the Wingate test, physiological determinants of running performance and fitness tests on anaerobic capacity. It was disappointing that some candidates did not attempt some questions at all.

Candidates need to understand that the eight-mark questions should be a focussed but sustained response on the question asked, but that the quality of response is more important than the length of the answer. Knowledge of key terminology remains important and definitions and key terminology should be learnt from the specification and the topic guides.

It is also important that candidates answer the question set rather than just giving knowledge on the topic area.

It was encouraging that the longer answer questions showed evidence of structure in better responses and that the key terminology and analysis is more evident in better responses.

9PE02 – Psychological and Social Principles of Physical Education

Principal Examiner Colin Maskery reports on many impressive answers for this paper as well as points for further improvement.

There were some excellent answers in the summer's exam suggesting that many candidates had been well prepared to the exam.

Some candidates would benefit from reviewing the 'command words' and their meanings in order to be confident on nature of demand for each question; as in previous years there was some confusion and candidates would benefit from having a thorough working knowledge of the requirements of each command word and how it might shape the response.

It was encouraging to see that candidates performed better in the extended 15-mark questions with both increased mean and mode scores.

Candidates should continue to prepare for the extended writing questions through practice in developing a structure when writing - particularly in producing shorter more discrete paragraphs, and to include both an interesting introduction and a conclusion or summary.

However, few candidates accessed the top band of marking mainly due to a lack of depth and applied knowledge to the specific question.

Some examples given by candidates were overly long when used to support a point being made which wastes time and writing space. Candidates should also ensure that factual details that are included are accurate.

Finally, evidence from this year suggests that candidates managed their time better with more completing the paper. For those who struggle with this aspect of examination technique, one strategy to consider is to complete the extended writing questions first.

These can always be revisited if additional content comes to mind.

9PE03 – Practical Performance

Chief Examiner Dennis Tattoo reflects on many excellent practical performances this summer.

The quality of performances observed in this series ranged from being good to outstanding, including a number of elite performers. As last year moderators were impressed with the attitude and enthusiasm of the candidates and of others involved in the process including other school team players or younger pupils for the coached sessions.

Moderators reported on well organised events with keenly motivated candidates who worked well and also that many teacher-assessors led well planned practical sessions.

Those who chose to be assessed as a coach seem to have responded to the feedback from 2018 and tended to be more pro-active in actually coaching rather than setting up good drills and watching and praising; coaches need to be seen affecting performance levels to score really high marks. the standard again ranged from good to outstanding.

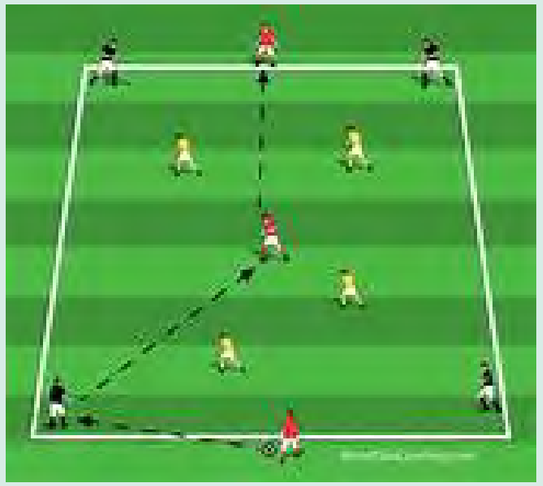
Although most sessions were designed to allow performers the chance to demonstrate skills in both formal settings and, when necessary, under the pressure of opposed scenarios, there were a few instances when the activities were not demanding enough for those marked in the top bands. Top band candidates need to be involved in pressured practices in order to show their best performances and enable centre marks to be confirmed.

As in previous years some centres provided recorded evidence. When this was done well, candidates were readily identified and the video provided appropriate evidence and a clear view of the candidates performing.

However, some of the video evidence was of a more limited quality. In these instances, moderators reported that candidates could not be clearly identified, that the recordings were of poor quality, and that the level of performances observed did not support centre marks.

It was encouraging to note that more centres provided evidence of skills, techniques and decision making under pressure, to meet the demands of a conditioned practice as well as the formal/ competitive situation, as required in the specification.

Centres and candidates are thanked for the high quality of much of the work observed.



Practices must be demanding enough to allow candidates to demonstrate their best performance.

9PE04 – Performance Development Programme

Chief Examiner Dennis Tattoo suggests that it was It was encouraging to note that a number of centres had responded to points made in the various reports from last year, although there are still areas for improvement across the task.

Physiological

Much of the work offered for this task was well organised and of good quality.
To achieve top band marks, candidates should be encouraged to undertake additional research so as to appreciate current trends in testing at elite level performance and not limit themselves to the standard tests readily available on popular websites.

As mentioned last year candidates should be encouraged to consider elite and peer level performances (age group at club and school) as well as normative data as this provides candidates additional possibilities for analysis.

Most candidates understood issues around reliability and validity but in some cases there was confusion and remains an area that candidates need to research in more detail.

Some candidates identified future priorities for training and development but this was missing from work moderated in band three or below.

Tactical

Relatively few candidates undertook the tactical work. Candidates often presented this work in an orderly and structured way and used annotated images to describe the tactic.

The best work included good analysis but it is important for all candidates to show how tactics can be applied in a competitive situation or how it might be adapted in changing circumstances, such as when team numbers are reduced because of injury.

Technical

This was often the best work and tended to include detailed and accurate annotated diagrams. Those who scored less well offered work which was primarily descriptive and did not include sufficient analytical detail.
Higher quality work also provided data to support a thoughtful analysis of strengths and weaknesses in order to justify key areas for development.

Planning of the PDP

Most candidates advanced their analysis into the PDP well and defined and applied SMARTER targets which were often applied accurately.

To score high marks though more work was often needed to fully explain how SMARTER targets underpins the planning of an effective PDP.

The work on principles and methods of training was often detailed and largely of a very good standard, although some candidates need to personalise this better to the demands of their own plan

All candidates should be encouraged to undertake research to identify more valid tests which can often be found on NGB websites or in technical journals.

A lack of research limited the marks for some candidates.

Evaluation of the PDP

This was quite often the weakest aspect of the PDP. Many candidates were disadvantaged because they did not apply words evenly across the four tasks and therefore had too few words to support their evaluation.

In a number of instances candidates would have benefitted from referring to qualitative data to support the overall effectiveness of the plan.

Examples that might be used to provide additional evidence of the benefits of the PDP would include a notational analysis of a performance and/or coach observations.

Centres should also encourage candidates to reflect on the changes in the test scores and refer to potential physiological changes where appropriate.

Recommendations for future development was frequently covered quite well but candidates might also make reference to the need for further modifying methods or principles of training or accessing additional research.
Finally, candidates should be aware that the word count for this work is 3500. Some candidates again exceeded this, in a few cases significantly.

Warming up

What's the point?

In the summer of 2019 contrasting events, the 5kms Park Runs, which are increasingly popular with recreational runners, and the World Cups for netball and cricket, were timely reminders about the debate surrounding the benefits to performers of warming up.

Leading knee surgeon, Amir Qureshi (quoted in The Times in an article by Tom Whipple), raised concern about how a lack of proper warming up by participants in the Park Runs had led to a growing number of knee injuries requiring medical intervention. He suggested that participants of all ages and abilities, including recreational runners who he thinks are usually less likely to warm up properly, should undertake a thorough warm-up in order to help prevent injuries.

The cricket and netball world cups saw athletes from around the globe preparing for competition with a thorough warm-up which included the well-established components of gross motor activity, flexibility activities, sport specific stretches and then sport-specific skills practices. Netball England, for example, advocate a warm up which includes landing skills, dynamic stretching and a series of activation exercises as well as games like 'Tag Ball'.

Warming up is included in the 2016 specification in several content areas in component 1 and is also relevant to components 3 and 4 where candidates undertake performance roles and produce a Personal Development Programme. What then is the evidence to support the role of warming up for improving performance levels and reducing injury?

Popular A level text books including Sport and PE (Wesson et al, 2000), Advanced PE for Edexcel (Galligan et al 2000) and AS Revise for PE for Edexcel (Roscoe and Roscoe, 2016) refer to the need for warming up to have a gradual increase in intensity and that an effective warm up enhances the quality of performances and can also reduce the risk of injury.

According to Haff and Triplett (2016) well designed and appropriate warm ups have a number of positive effects on performance. These include faster muscle contraction, enhanced rates of force development and muscle strength and power, and an improved delivery of oxygen due to the Bohr effect as higher temperature enables oxygen release from haemoglobin and myoglobin.

Although there are relatively few quality studies investigating the impact of warm ups on performance Fradkin et al (2010) undertook a review of studies which had considered the impact of warming up on sporting performance.

The review concluded that a proper warm up, comprising aerobic exercise, stretching and then activity similar to the event, had a positive effect. Interestingly, the review also noted that recreational and amateur participants were less likely than elite athletes to warm up thoroughly, which supports the position taken by Doctor Qureshi.

An effective warm up has also been linked to decreasing the risks of injury. Safran et al (1988) found that increasing muscle temperature can improve the resistance of muscle to tearing. However, there are a limited number of studies about warming up and injuries. In a review of studies in 2006 for Sports Medicine Australia relating to warming up and its effect on preventing injury, Fradkin et al considered five detailed studies which had focussed specifically on the impact of warming up on reducing injury.

Three studies found that a warm up significantly reduced the risk of injury, whilst the other two suggested that warming up was not effective in significantly reducing injuries.

The review concluded that the evidence suggested a link between warming up and reducing the risk of injury, although more research was needed to determine the role of warming up in injury prevention.

The RAMP protocol is one way for candidates to remember the constituents of an effective warm up (see Jeffery 2007).

RAISE	Approximately five minutes of low intensity, multi directional movement to enable a raising of: • Temperature • Heart rate • Respiration • Blood flow • Joint viscosity
ACTIVATE and MOBILISE	A further five minutes should be allocated to activate the key muscles and mobilising the important joints important for the activity. Examples might include: • Dynamic balance work • Squats and lunges • Trunk mobility exercises
POTENTIATE (Performance)	The final phase is concerned with preparing more specifically for the activity or performance. For up to ten minutes, the intensity of the work should progress to be in line with the demands of the activity about to start and include sport specific practices. For example, in football this might include a 'Possession with Purpose' drill.

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Respiration and Ventilation

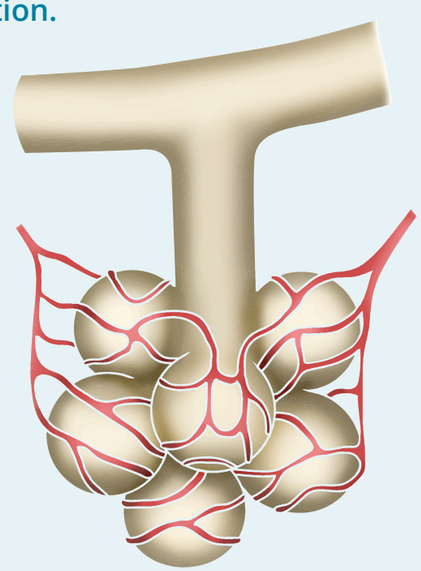
Principal Examiner Ellie Bunston summarises the key differences between the ventilation process and respiration.

These processes are both involved in the supply of oxygen to the body but can be confused.

Ventilation: is the movement of a volume of gas into and out of the lungs – this covers the provision of air to the lungs.

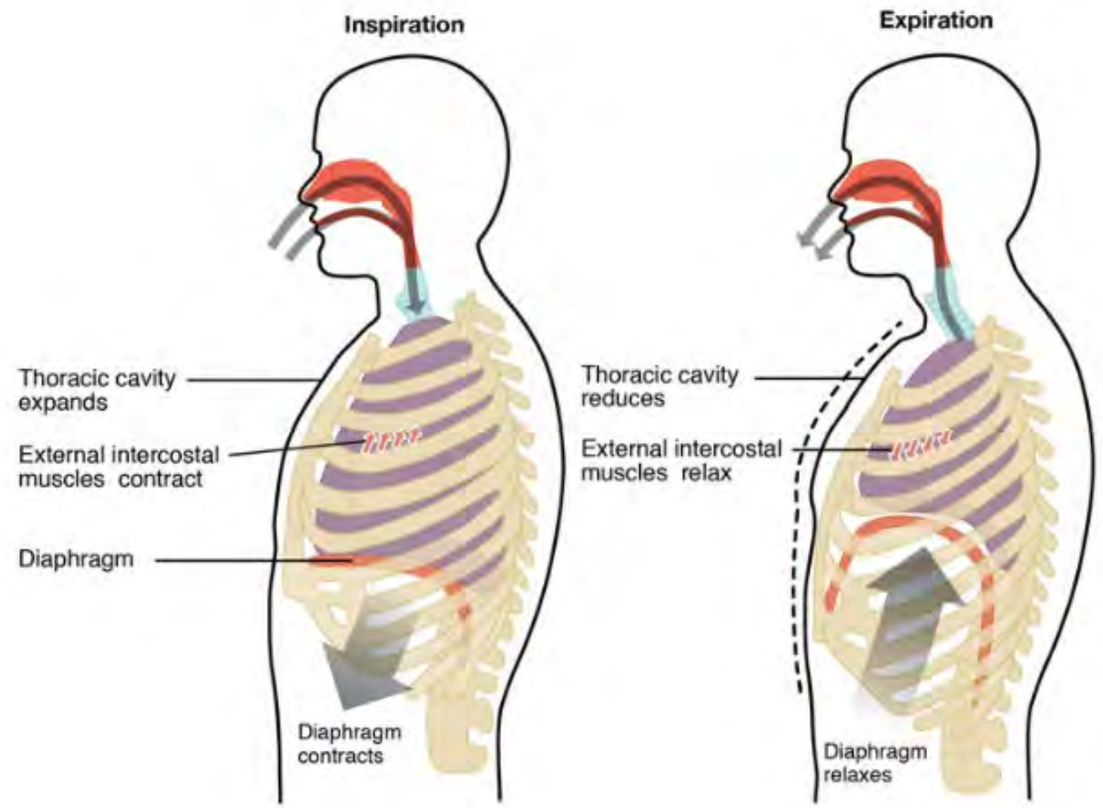
Respiration: is the exchange of oxygen and carbon dioxide across a membrane – either in the alveoli of the lungs (external respiration) or at the cells (internal respiration).

The respiratory system extends from the nasal cavity to the alveoli.



Key differences

Ventilation	Respiration
Process of taking oxygen to the lungs but does not include gas exchange.	Takes place in the cells and is the gas exchange.
Involuntary – however, can be voluntary as you can consciously alter depth and rate of breathing.	Involuntary
Includes – nose, pharynx, larynx, trachea, bronchi, bronchioles, diaphragm, intercostals	Can happen in alveoli or cells (external or internal) and capillaries.
Includes both inspiration and expiration based on pressure differences/gradients between air and lungs.	Occurs by diffusion and exchange of oxygen and carbon dioxide – can be external or internal – results in oxygen being taken up by Red Blood Cells. Partial pressure differences of gasses are critical.
Physical process	**Chemical process**



Ventilation includes both inspiration and expiration based on pressure differences/gradients between air and lungs.

Priming exercise

This article is a detailed follow up to an earlier article in Inside Track (September 2017) on a topic that can sometimes be difficult to locate information.

At the beginning of exercise, the aerobic system is slow to start, you will know this because it takes a few minutes to reach steady state.

Priming exercise is used as part of a warm-up to increase how quickly the aerobic system 'boots up'. Before looking at how to do priming exercise, it is first important to understand two fundamental aspects of exercise physiology.

Firstly, you need to know about **exercise domains** and secondly what happens (physiologically) when exercises are performed in each domain.

Exercise domains

To understand priming, you need to understand exercise domains or exercise intensity domains as they are sometimes called; but what are they? An exercise domain is a range of exercise intensities e.g. 50-70% $\dot{V}O_2$ max, where the physiological responses to exercise are the same; more on this shortly.

Depending on what you read you will come across either three or four different domains; moderate, heavy, severe (occasionally called very heavy) and extreme (many people ignore extreme).

The exercise domains can be identified during laboratory testing by measuring blood lactate and expired gases during an incremental test.

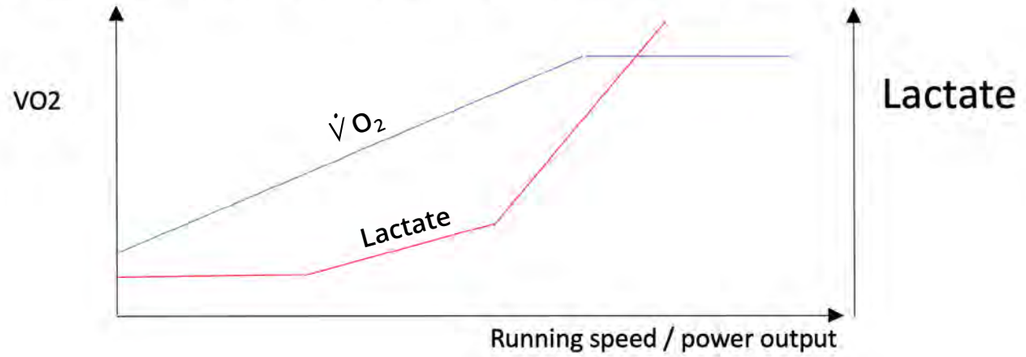
Typically, an incremental test will require the athlete to run (or cycle) for a series of stages, usually 3-4 minutes long, each one at a progressively higher intensity until exhaustion.

Essentially, this is the same test as that used to measure maximum steady state and $\dot{V}O_2$ max.

Blood lactate and $\dot{V}O_2$ responses to this type of test are shown in figure 1, for lactate there are two distinct thresholds.

Confusingly, these thresholds have many different names and different people have used the same name to mean different thresholds.

Fig 1 – oxygen uptake and blood lactate responses to incremental exercise



The name of them is not so important. In fact some refer to them as the first and second thresholds. What is important however, is what they represent.

Working backwards, the second threshold is the maximum steady state or highest intensity where a steady state can be reached.

It is also often called the lactate turnpoint, anaerobic threshold, functional threshold, critical speed / power or OBLA.

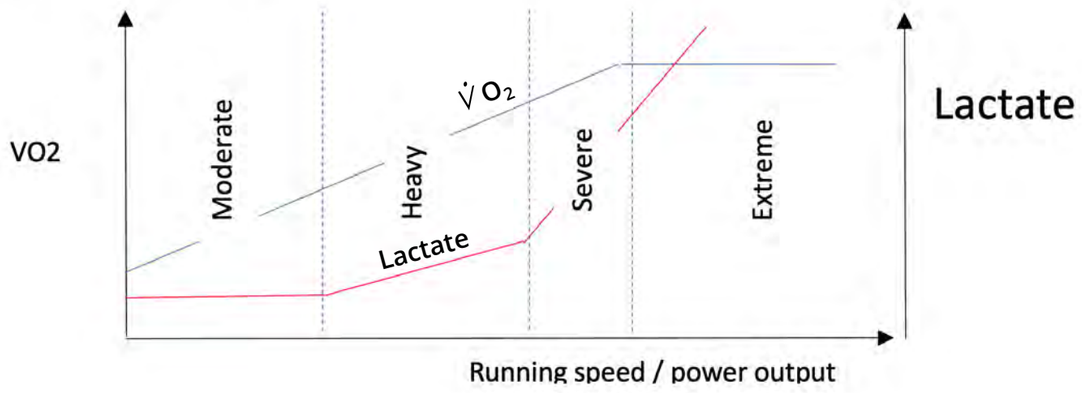
Exercise scientists hotly contest the correct term but maximum steady state is the safest term to use.

The maximum steady state is the boundary between the heavy and severe domains, with the first threshold representing the boundary between moderate and heavy domains.

Any exercise below the first threshold is performed in the moderate domain, while the severe domain extends from the maximum steady state up to $\dot{V}O_2$ max, anything above this is in the extreme domain (see Fig 2).

Now that the domains have been identified, the next step is to consider how the body responds exercise in each domain (acute responses to exercise).

Fig2 – exercise domains



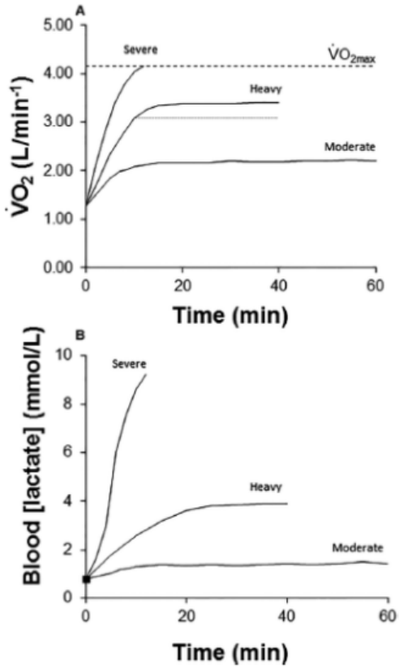
Physiological responses when exercising in each domain

The oxygen uptake and blood lactate responses to exercise at any intensity within a domain are the same, however the responses are distinctly different for each domain.

These distinct responses affect how long someone can exercise within each domain before becoming fatigued, also the mechanism(s) of fatigue in each domain are different (see Fig 3).

Each domain will now be considered in turn. Once the responses to exercise in each domain are understood, we can then look at the effect of priming exercise performed in each domain.

Fig 3



The descriptions below assume that the exercise is being performed at a constant speed or power output.

Moderate domain

Exercise in the moderate domain is characterised by two key features; reaching a steady state oxygen uptake, heart rate and ventilation within 2-3 minutes of the start and a blood lactate value that is similar to rest.

Within this domain exercise is exclusively aerobic, it includes sports such as marathon running, trail running or long distance cycling. Fatigue within this domain (exercise lasting three hours or more) has not been studied very much but is thought to include a loss of muscle activation from the central nervous system.

Heavy domain

In the heavy domain steady state is still reached but it takes longer than in the moderate domain, it can be up to 10 minutes. Blood lactate rises above resting levels but reaches a steady state during sustained exercise (see Fig 2). Exercise in this domain can be performed for between approximately 40 minutes and 3 hours and is limited primarily by glycogen depletion. Typically exercise in this domain is usually between 60 and 85% $\dot{V}O_2$ max.

Severe domain

This domain extends from the maximum steady state up to $\dot{V}O_2$ max. Within this domain it is not possible at achieve steady state, $\dot{V}O_2$, blood lactate and hydrogen ions [H^+] increase throughout the exercise. If the exercise lasts long enough $\dot{V}O_2$ will increase until it reaches $\dot{V}O_2$ max. The point of fatigue will usually be reached between 40 and 3-4 minutes.

Extreme domain

Exercise in this domain lasts less than a couple of minutes and is performed at an intensity greater than $\dot{V}O_2$ max. Steady state is not obtained, lactate, H^+ and $\dot{V}O_2$ all rise throughout the exercise, although there may not be time for $\dot{V}O_2$ to reach $\dot{V}O_2$ max (this takes 90-120 seconds). The cause of fatigue is hotly debated with H^+ build-up, the depletion of anaerobic capacity or some form of 'sensory tolerance' e.g. the central governor all suggested as possible causes.

Priming exercise

What do exercise domains have to do with priming exercise? Research looking at priming exercise is conducted using exercise domains.

Early work looked at the effect of performing priming exercise in either the moderate or heavy domains on a subsequent bout of exercise.

In essence, they were looking at the effect of the intensity of a warm-up activity. This early work found that priming exercise in the heavy, but not moderate, domain, reduced the time to reach steady state, therefore reducing the amount of anaerobic energy required at the start of exercise.

Almost all of the early work looked at the physiology rather than performance.

More recent research has shown improvements in performance from priming exercise performed in both the severe and extreme domains, provided that it does not result in exhaustion and there is sufficient time for recovery to occur.

The length of recovery required is usually between 10 and 20-minutes, whereas when only a few minutes are given performance is worse.

It is noteworthy that improvements in performance exist so long after the priming activity.

Examples of severe or extreme domain priming activity include 6-minutes at the mid-point intensity in the severe domain, or 200-m at race pace (extreme domain) prior to an 800-m race.

These priming activities were however performed after several minutes of moderate domain exercise.

How does priming work?

The underpinning physiology is not entirely clear but the possible mechanisms include:

i) A quicker rise in $\dot{V}O_2$ at the start of exercise.
This reduces the use of the anaerobic energy system delaying or offsetting H^+ build up and reducing the use of the anaerobic capacity.

ii) Greater vasodilation.
This vasodilation is still present when the activity begins meaning a greater supply of blood to the working muscle.

iii) An activation of the enzymes used in Kreb's cycle and the electron transport chain, enabling the aerobic production of ATP more quickly.

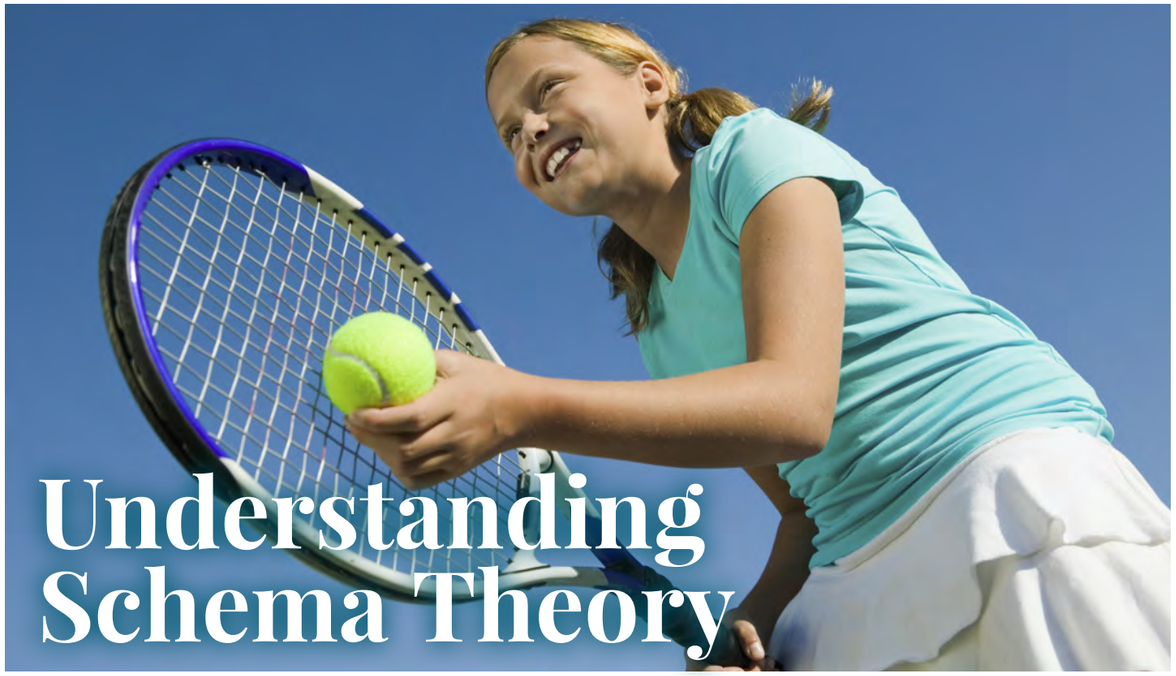
iv) an increase in the number of muscle fibres recruited during exercise.
Each fibre therefore does not have to work as hard.

Conclusion

Priming activity in the severe or extreme domain that does not cause exhaustion and is followed by a long enough recovery period enhances subsequent performance.

The underpinning mechanisms have not been fully established but several mechanisms have been proposed that could operate independently or together.

Some references for this article taken from:
Physiological Report - 2019 | Vol. 7 | Iss. 10
The maximal metabolic steady state: redefining the 'gold standard'
Andrew M. Jones1 , Mark Burnley2 , Matthew I. Black1 , David C. Poole3 & Anni Vanhatalo1



Understanding Schema Theory

Principal Examiner Colin Maskery summarises scheme theory, an important topic for component two of the specification.

Schmidt (1977) tried to explain how we learn and perform 'discrete perceptual motor skills' (DPMS) and through his schema theory tried to overcome some of the limitations found in the Closed-Loop Motor Control Theory proposed by Adams(1971).

A DPMS is explained as:

- Discrete: Skills that take a short time to perform with a distinct beginning and end
- Perceptual: Involves our senses to understand what is happening - cognition
- Motor: Using our bodies to take action – movement
- Skill: The whole action built from the particular technical elements or sub-routines

Fast ballistic movements such as a golf swing only provide feedback after their completion, therefore intrinsic feedback while 'felt', is not available to make adjustments while the DPMS is being performed.

Schmidt suggested that a unique stored individual motor programme for every skill we perform is both unfeasible, and retrieval would delay decision making and then the performance.

Performers could not store a plan of every single shot executed in tennis or passes in football and hope to instantly find the right one when needed as sporting circumstances are never exactly the same.

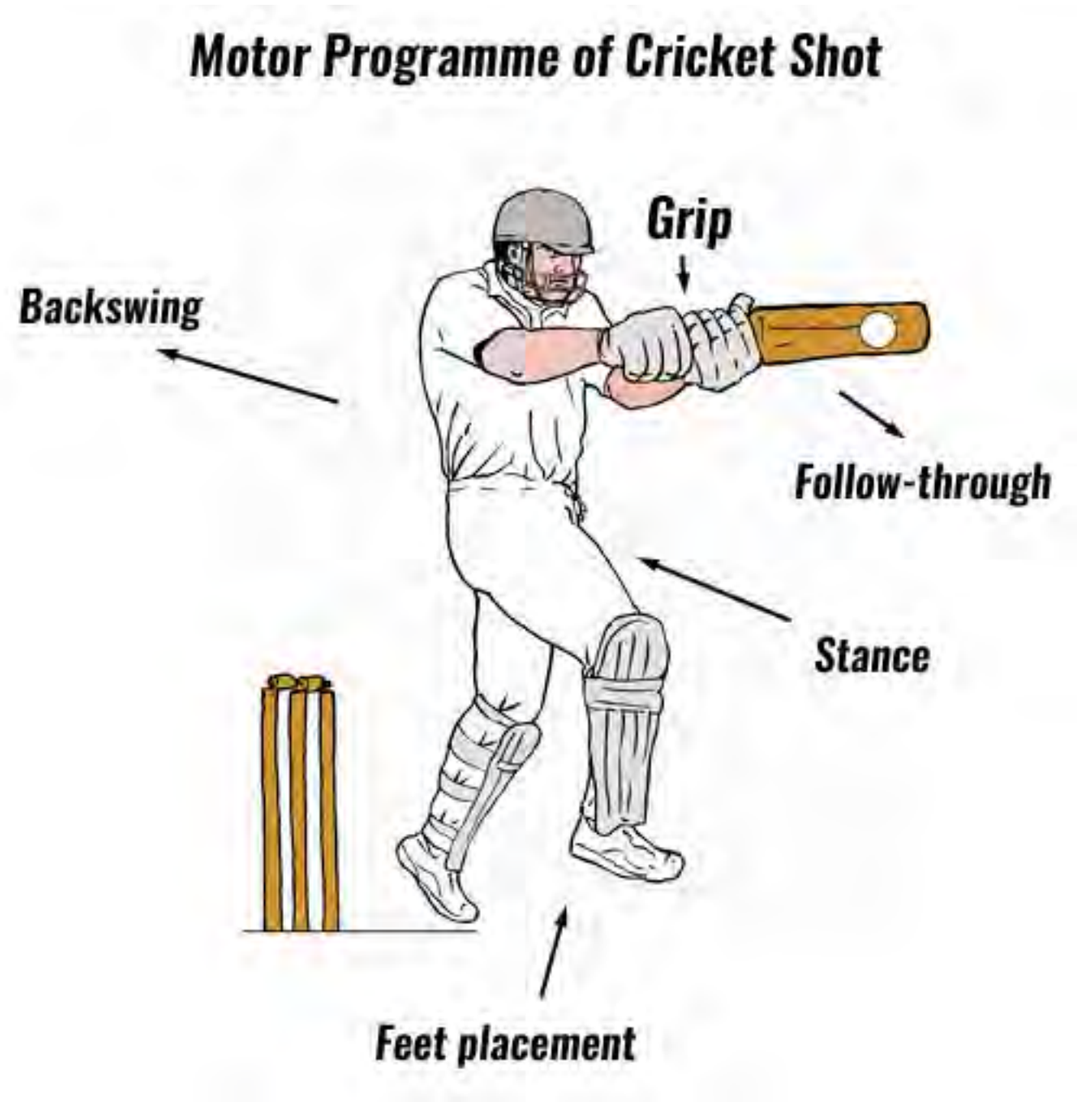
Motor programmes are changeable to respond to the specific performance situation.

In order to perform a skill, a ***Generalised Motor Programme (GMP)*** is used and is an individual basic form of all our movements.

Motor Programme: A series of subroutines organized into the correct sequence to perform a movement. Stored in the long-term memory and retrieved when we need to perform the skill. Sub-routines are the many basic actions that combine to enable a skill to be performed.

A GMP is, by definition, generalised as it needs to be adapted to the particular circumstances at the moment the motor programme, or skill, is to be performed. In a tennis forehand stroke, the height of the ball, speed, spin of the ball, location on court and the movement of the opposition are some of the factors to be taken into account. The GMP is adapted as perceived by the performer.

Once the action required or skill is selected the subroutines need to be put into the correct sequence. For example: The motor programme for a cricket shot stores the subroutines in the correct order (stance, grip, feet placement, backswing and follow through). What must be added is information about the individual circumstances of the occasion or moment the skill is to be performed.



Schmidt developed his concept of the GMP with two further aspects of his theory – those of ***Recall and Recognition Schema***. These are linked together and are the bits of information that are used to adjust a GMP to the particular circumstances of that time and then to store information about the execution of that particular skill.

Recall schema – This occurs before a movement is initiated and includes the information which the performer must know in order to adapt the GMP and form a new schema:

Initial Conditions:

- Where is the goal, opposition or teammates?
- What is the environment like – playing surface, weather conditions?
- How do I feel – confidence, tired?
- Speed of a ball, height, trajectory, spin
- Outcome requirements – accuracy, required force or power
- Pressure to produce a successful outcome

Included in this is the **Response Specification**

- Before a new skill or movement is initiated specific information, or parameters, are needed to provide the performer with information
- Now using the information gained from the recall schema, the bits of information that the performer now knows, a new motor programme is formed
- The subroutines are combined together as perceived necessary by the performer
- A new, enhanced and more detailed version built on and from the GMP is ready to be executed

Recognition Schema

This occurs after the performance of a skill. In order to evaluate, correct or alter a future response and centres on the subsequent knowledge of the performance (KP) and the knowledge of the results (KR) and the performer needs to know four things;

1) Initial Conditions of the movement such as proprioceptive information of the limbs and body. Did it feel right? (KP)

2) The response specifications for the motor programme, this is the parameters used in the GMP such as speed and force (KP)

3) The sensory consequences of the response which contains information about how the movement felt, looked and sounded (KP)

4) The outcome of that movement, or the response outcome, contains information of the actual outcome of the movement (KR).

From the *Knowledge of Performance and the knowledge of Results* the performer wants to know if the adapted GMP was correctly formed, executed successfully producing the desired outcome?

The end result is that the comparison made between the actual outcome and the intended outcome updates the memory store for future reference when a similar skill based on a GMP is required.

Resources Review

Books, websites and technology

Chief examiner **Dennis Tattoo** continues Inside Track's regular review of the latest sports technology, books and websites, which teachers and students might find of interest.

Kinovea sports analysis

Developed by Joan Charmant, Kinovea is one of a growing number of free resources that enables performers and coaches to download free software which can be used to capture action from training and matches which can then slowed down, studied, compared, annotated and analysed.

Some centres studying the Edexcel A Level take advantage of the excellent facilities at many universities for field trips to enable candidates the chance of using analytical tools for the performance analysis task.

Essex University is one location where Kinovea is used and where students can develop skills of enhancing the quality of video material by adding details such as directional arrows and descriptions to vital positions and by comparing two recordings simultaneously and synchronising them to identify where techniques can be further improved.

More information is readily available at: **https://www.kinovea.org/**

Polar Ignite

The Polar Ignite is a recent addition to the Smartwatch family and offers support to more than one hundred activities.

The watch is fitted with FitSpark a training programme that can be personalised to take account of training history, sleep patterns and other factors to suggest an exercise programme and encourages the wearer to also consider recovery to maximise the potential of the exercise regime followed.

It has GPS and heart rate monitor functions and also has features such as sleep stage analysis.

The watch is becoming increasingly affordable and has added another layer of data for wearers to utilise to underpin training.

Mind Games – Annie Vernon

Olympic and world championship rower Annie Vernon, offers readers an interesting insight into the complexities of achieving success in sport. Although the front cover refers to the psychology of elite athletes, the author also considers other factors which impact on the development of elite performance.

Readable and accessible, it is not essential reading for candidates studying A level PE but offers interesting insights into several topics on the specification including motivation and confidence and has the advantage that it engages with a wide range of sports and performers.

Worth a read.