ANALYSIS of Performance Data for Exercise Physiology

(40 pages)

INTRODUCTION

Levels of performance change all the time. Improving for a variety of reasons - including increased understanding of physiology, nutrition, training regimes, technique, equipment and doping. Plateauing or regressing as a result of changes in implements as with the javelin to keep it within safe distances in the stadia, increased doping control, and gender issues in women's events.

THE DATA ANALYSED HERE IS NOT CURRENT:

a) SO AS TO AVOID ANY IMPLICATIONS FOR THE PERFORMANCES OF THOSE STILL ACTIVE;

b) DUE TO DIFFICULTIES OF FULLY UNDERSTANDING THE IMPACT OF INCREASINGLY SOPHISTICATED DOPING METHODS

c) TO PROVIDE A HISTORICAL PERSPECTIVE.

Therefore, although performance data changes all the time, the value of the physiological insights offered by the techniques used here remain valid and provide an opportunity for those so disposed to keep them up to date with data easily available online

Contents

Introduction

Students without a background in biology tend to find the subject of exercise physiology difficult, particularly if the subject is presented as a modified version of human biology. The plethora of descriptive terms and definitions, basic chemical and physical concepts and much more, tend to alienate new comers to the subject before any connection can be made to their intrinsic interest in PE and Sport Studies. Experience has shown that by taking a performance based approach, interest and enthusiasm can be kindled, before any realisation that a subject known as exercise physiology is being studied.

All parts of the subject do not lend themselves to this approach, and the material presented here is selective. However, it is hoped that once familiar with the approach, users will be able to build on this base, year by year.

Whilst recognising the need for clarity of organisation and presentation, the seamless nature of the subject renders it difficult to avoid interconnections, and once a certain level of confidence is gained such interconnections can be very useful in bringing things together.

The data is presented in a variety of ways to illustrate some of the different ways in which they might be analysed, and students should be encouraged to devise their own ways of presenting them.

The Notes provide the key information on each image. The black and white miniatures of the images in the Notes, link the Notes to the full size black and white and full colour versions of the Images. However, if enlarged sufficiently the miniatures will reveal full details.

Units

Special Note on units of volume

The litre *(l)* and millilitre *(ml)* are still widely used in exercise physiology, but they are not SI units, and the symbol for litres *(l)* can cause confusion eg 1.0 l. The System Internationale *(SI)* of units is intended to be used universally. Therefore the terms 'decimetre cubed' *(dm^3)* i.e. 10 cm x 10 cm x 10 cm *(1000 cm^3)* and 'centimetre cubed' (cm^3) are the more consistent and are used in all sciences, as they are here. The persistence of the litre in exercise physiology could be explained by the extensive involvement with non-science trained athletes and coaches, to whom the term decimetre cubed would be unfamiliar compared to the litre which is in common use in everyday life. A situation rather akin to the persistence of the calorie as a unit of energy in the face of the more scientifically correct SI unit the joule.

Special Note on units of oxygen uptake

Oxygen uptake is shown as VO_2. The units used can be cm^3 per minute, and may be quoted per kilogram of body weight. This can be shown as VO^2 $cm^3.min^{-1}.kg^{-1}$. Another convention is to use a dot over the V to indicate 'per minute' eg. $\dot{V}O_2$ $dm^3.kg^{-1}$ thus removing the min^{-1} from the units

Special Note on units of heart rate

Heart rate is measured as beats per minute. This is frequently and more familiarly shown as 'bpm', and more correctly as $b.min^{-1}$. Both are used here.

Analysing Elite Performance Data

Analysing Performance Data

Some elite athletic performance data has been selected and analysed in a number of ways. Athletic events lend themselves particularly well to this approach as a result of the 'simplicity' of their demands on the body systems.

An analysis of running performances throughout the whole range of competitive distances illustrates many interesting physiological principles.

The data can be plotted in any number of ways, and each different choice of axes should reveal fresh insights into the performance and its underlying physiology. In these notes the data has been plotted in several different ways, not because they are the 'best' way of presenting the data, but simply to illustrate a range of different approaches, which is by no means exhaustive.

As with all events, the pattern of performance is virtually dictated by the underlying physiology - which is the main theme of this approach. Once it is clearly seen that sport performance is the expression of the underlying physiology, then students should be well motivated to study that physiology.

Furthermore, an understanding of the superlative elite performances should induce a deeper appreciation of the functioning of the body systems to be studied.

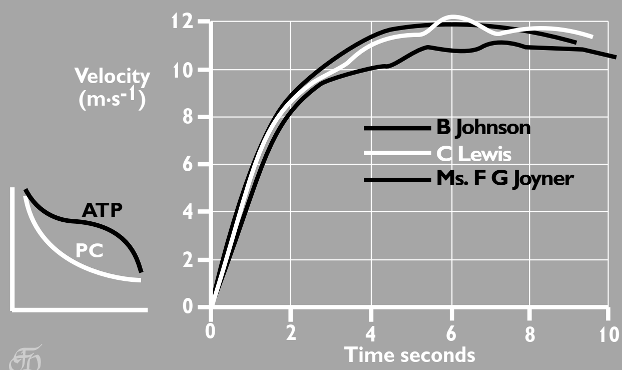
100 metres Olympic Finals

Image 1

100 metres Olympic Finals 1

Data from IAAF Biomechanical Analysis Programme 1988 Seoul Olympics 100m Finals

Distance metres	B Johnson seconds	C Lewis seconds	Ms. F G Joyner seconds
0	0.00	0.00	0.00
10	1.83	1.89	2.00
20	2.87	2.96	3.09
30	3.80	3.90	4.09
40	4.66	4.79	5.06
50	5.50	5.65	5.97
60	6.33	6.48	6.89
70	7.17	7.33	7.80
80	8.02	8.18	8.71
90	8.89	9.04	9.62
100	9.79	9.92	10.54



The levelling off, and/or dropping off, of the velocity/time curve can be interpreted on the basis of ATP/CP depletion in flat out sprint activities.

Although all energy systems contribute at any one time, the ATP/PC or phosphagen system supplies most of the energy in the first few seconds, with an increasing contribution from the anaerobic lactic system towards the latter part of the event.

The transition from one majority system to another raises discussion about the concept of ‘physiological thresholds’.

The untimely death of Ms F G Joyner at the age of 38, raised fresh speculations about drug abuse, but the autopsy revealed no evidence of such. Interesting background points for discussion behind these performances are that; Ben Johnson was disqualified and banned as a result of a positive test for steroids, and that quite amazingly from a ‘nature versus nurture’ point of view, two out of the first three were Jamaican born *(Johnson(1st) running for Canada, and Christie (3rd) running for Britain)*.

Donovan Bailey’s 10 m splits in his World Record 9.84 s winning run in the 1996 Atlanta Olympics were: 1.9, 1.2, 1.0, 0.8, 0.7, 0.9, 0.9, 0.8, 0.8, 0.84; reaching a maximum speed of 12.1 metres per second *(27.1 mph)* just before the 60 metres point.